THURSDAY, JULY 20, 1882

PERMANENCE AND EVOLUTION

Permanence and Evolution; An Enquiry into the Supposed Mutability of Animal Types. By S. E. B. Bouverie Pusey. (London: Kegan Paul, Trench, and Co., 1882.)

THIS is a thoughtful little book, clearly and ably written, with the view of showing, as its Preface states, "that while Darwinism proper is improbable, evolutionism in any form is as yet unproved; while, on the other hand, the more we investigate the facts of inheritance, the more we are compelled to regard differences so slight, that they would usually be considered casual variations, as within the limits of our existing knowledge strictly permanent." Such being his theme, Mr. Pusey introduces it with the following very appropriate and judicious apology, which we quote in order to show the spirit which throughout characterises his work.

"It may seem almost presumptuous on the author's part to attempt to reopen once more the whole question of evolution, especially as in doing so it is necessary to call in question the views of so many very eminent men of science. At the same time, any one who calls attention to any neglected facts, or who questions assumptions too carelessly allowed to pass muster, helps to elucidate the subject of which he treats, and so aids the cause of scientific knowledge, whether the particular views he propounds are right or wrong."

Having already observed that the work is one of marked ability, we have only further to preface our analysis of it by fully assenting to this justification. Although, as we shall immediately proceed to show, we do not think that Mr. Pusey has been successful in his tilt against the stone wall which has been reared by the school of Darwin, we nevertheless respect his independent disregard of mere authority, as we think that such disregard always deserves to be respected in matters of science where evidence is shown by the malcontent of clear and forcible thought of his own upon the doctrines which he undertakes to criticise.

The principal part of "Permanence and Evolution" is occupied with a criticism of the argument from classification, and especially that part of the argument which has reference to domestic animals. In the author's view Mr. Darwin has failed to prove in the case of any domestic animal that artificial selection has produced a new variety or sub-species. Thus of the varieties of the dog he says, "seeing how true they breed, I do not see why the principal and best marked (the greyhound, the mastiff, the terrier, the spaniel, &c.) should not have so existed (*i.e.* in a state of nature), and the others have been formed by crossing between them." Similarly of the pigeon he says there is no sufficient evidence to show that all the fancy-breeds were not once natural breeds which have since become extinct as such, or that their occasional reversion to the rock dove is not due to an ancient cross with it. "As these races resemble the rock dove, and each other, in everything except one or two conspicuous points, it need not surprise us that they produce perfectly fertile offspring," &c. Thus also he treats of the cases of all the other domestic animals alluded to by Darwin.

Concerning this mode of criticism, it seems enough to point out the cumulative improbability of all the domestic races of animals having once been wild (notwithstanding the apparent unfitness of some of them to a self-dependent mode of life), added to the further cumulative improbability of all these wild races having become extinct. We do not say that the hypothesis is impossible, but clearly it is so far improbable that even if there were no other evidence of the mutability of animal types, it would be more likely that the domestic races had been produced by artificial selection (and so that animal types are thus far changeable) than that they are all the remnants of more or less fantastic natural forms now as such extinct. If the hypothesis of "Permanence" has to stand upon so improbable a supposition as this, it is so far a less reasonable hypothesis than that of "Evolution," and therefore Darwin is justified in adducing the facts in question as evidence of transmutation to this extent.

But Mr. Pusey carries his criticism further than this, and says:—

"Granting that natural selection with spontaneous variation could within the period of history develop out of a rock dove a fantail, I do not see how we are any nearer the conclusion that in ten times or a hundred times that period these causes would develop the Goura pigeon; granting that, that a millionfold as much time would evolve any of the true Gallinaceæ."

This way of treating the evidence is, however, hypercritical. It is certain that either "Permanence" or "Evolution" is the truth, and therefore, if it were established, or taken for granted, that within the historic period selection is able so far to change an animal type as to convert a rock dove into a fantail, the presumption becomes immense that in a hundred times that period the operation of similar causes might develop a Goura pigeon. Thus, in view of the supposed assumption or proof we certainly *are* "nearer the conclusion" in question than we should be in the absence of a case analogous in kind though not in degree.

Similarly in dealing with the argument from affinity, we think that Mr. Pusey is hyper-critical. He points to the fact that crystals occur in natural systems, and that their similarities cannot be due to genetic descent; but this analogy is clearly too lame to support any weight of argument, and the same remark applies to his analogies drawn from the similarities found in inorganic nature generally. For in all these cases the similarities occur in objects of far less complexity than organised structures, and therefore the similarities are much less remarkable, while in the case of organisms the known facts of heredity furnish much the most probable explanation of the much more complex similarities. This, perhaps, may most briefly be shown by quoting the alternative hypothesis which our author presents, for clearly it is one which no man of the commonest judgment could for a moment entertain. He suggests that systematic affinity may be due to the resemblance between the chemical elements (? and compounds) of which organisms are made up, and adds what we must regard as a scarcely serious observation—"This hypothesis, though totally without positive evidence to support it, is in itself quite as clear and definite, and (what is called) explains the facts about as well as the hypothesis of evolution."

Mr. Pusey's treatment of the evidence from rudimentary organs does not seem to us more fortunate. His only criticism here is that because organs are rudimentary we have on this account no warrant for concluding that they are useless; "if these aborted structures were the only ones in which we could see no use, then the explanation would have some *locus standi*." But here the important fact is lost sight of that all rudimentary organs are the *homologues* of organs which when of larger size present observable utility. Can it be reasonably supposed that in the case of all the thousands of these "aborted structures," some new function, always unobservable, is performed by an organ which by some strange chance happens to be the homologue of an organ which when of larger size performs some other and observable function?

Again, the argument from embryology obtains but very scant justice; only three pages are devoted to it, and the core of the subject is not touched. For the force of this argument does not consist in our seeing "a vast number of animal forms, many of which are very like each other, and their distinctions less pronounced in youth," or in such cases as that of the stripes on the young lion, &c. The force of the argument consists in the progressive imitation of lower morphological types by the successive embryonic stages of higher ones; and of this very remarkable fact Mr. Pusey takes no notice.

The argument from palæontology is dismissed in a similarly high-handed fashion, but somewhat more consideration is given to the argument from geographical distribution. The view advanced is "that the facts of distribution can, to a great extent, be shown to have originated in an opposite manner, not by the origination of new forms, but by the destruction of old ones." If this could be shown, no doubt the proof would be one of much importance to science, and would serve largely to modify the argument from distribution; but the fact certainly has not been proved, or even shown to be generally probable, by the book before us.

Concerning the specially Darwinian theory of evolution Mr. Pusey says that personally he thinks "whatever else is the origin of species, natural selection certainly is not." His reasons for this opinion are that *a priori* the way in which we should expect natural selection to act "would be by conferring fertility, hardiness, and early maturity" (none of which qualities are presented by the higher Primates); and also that allied animals living on the same areas and apparently exposed to similar conditions of life, are nevertheless "dissimilar in a number of minor points, apparently unconnected and without teleological purpose." Now concerning the first of these objections, it seems enough to observe that *a priori* considerations of this kind are extremely hazardous. Fertility, hardiness, and early maturity may all be good for species, and yet other qualities (perhaps incompatible with them) may be even better, such as high nervous organisation, intelligence, &c. In short, where the conditions of the problem in any given case are so many and complex, it would be idle to determine beforehand what qualities we should expect natural selection to lay a premium upon—as much so, for instance, as to say, after the event, that a man would be better suited in his environment if he had had a very much more brutal constitution, could run about like a chicken when a few hours old, and was the most prolific animal in creation. And of course the other difficulty, being of a similarly *a priori* kind, admits of being similarly met. There may be a thousand unobservable reasons why, after a long course of evolution, allied species living on the same areas should be dissimilar in minor points of structure, colour, &c.

We have now briefly noticed all the leading points in Mr. Pusey's criticism, and if we had more space we might go more in detail with him. But we have said enough to show that we deem his strictures throughout to err on the side of over-scepticism. In science, as in everyday life, true judgment is shown, not by suspending our decision until a theory is demonstrated by observation, but by yielding assent to probability in a degree commensurate with the evidence. At the same time, it is, of course, most important that a clear distinction should always be drawn between a probability, however high, and a proved fact. In every department of inquiry, therefore, the hyper-critical mind is of service in insisting upon this distinction when there is danger of its being neglected; and in view of this consideration we think there are many evolutionists who would do well to read Mr. Pusey's work. As we have already said, we do not consider that this work has in any way affected the main evidences of evolution; but it is well calculated to steady the course of speculative thought in a direction where with less hurry there may be more speed.

GEORGE J. ROMANES

CRYSTALLOGRAPHY

Geometrische Krystallographie. Von Dr. Th. Liebisch (Leipzig: Wm. Engelmann, 1881.)

THIS is the most complete and exhaustive book on crystallography which has been so far published, and it is especially characterised by the importance assigned to the dualism observed in crystallographic problems considered as relations of a system of planes or lines connected together by the law of rational indices. The book consists of three main parts—the first dealing with the general relations of a system of planes and lines subject to the law of rational indices; the second with crystallographic representation and construction; and the third with the developments of the six crystallographic systems and the determination of crystals.

The general problems in the first part are treated by the processes of modern geometry. The problem of the transformation of the axial system is very exhaustively treated, but curiously enough Dr. Liebisch seems unacquainted with the elegant solution of this problem, given by the late Prof. Miller in his Tract on Crystallography (1863). The analysis of this problem, given by Dr. Liebisch, is laborious and somewhat complicated, and the results are not really more general than those of Prof. Miller. Dr. Liebisch has entered into the question of the conditions of perpendicularity in a crystal system, but his analysis is not so elegant as that of Prof. H. J. S. Smith, nor is it capable of more ready application than the latter. The chapter treating of this portion of the subject is largely occupied by the proofs of the ordinary propositions of spherical trigonometry by means of a cumbrous notation and an analysis of great difficulty. One can hardly believe that this analysis is needed by

German students, and its introduction is to be regretted, as it is likely to deter scientific students from taking up crystallography.

In the special part devoted to the several systems, Dr. Liebisch proceeds from the principle of symmetry, in which, however, he defines his systems by means of axes and a centre of symmetry, instead of by planes of symmetry. This is done with a view to include the hemihedral forms in the same definition as the holohedral ones, and to obviate the difficulty arising from the hemihedral forms being excluded when the system is defined by means of planes of symmetry. One doubts, however, whether the advantage gained is sufficient to compensate for the loss of simplicity. Dr. Liebisch has made a curious slip in his definition of symmetry, being apparently carried away by his love of generalisation. He shows that the internal and external bisectors of an angle divide symmetrically the spaces portioned out by this angle, and that the four lines form a *harmonic* pencil. He then generalises this relation, and leads one to suppose that symmetry always exists when a pencil is harmonic. The fallacy of this is clear when one considers that the planes 100, 101, 001, and $\bar{1}01$ in the oblique system would thus show symmetry, since they are harmonic conjugates. Dr. Liebisch points out that the indices of the planes in a form can be deduced from those of one of the planes when the symmetry is given. The deduction though simple is sufficiently difficult, and it would have been better to have given it fully. Another omission is found in the problem of isogonal zones, *i.e.* the determination of the possible angles between planes of symmetry. The solution is carried out so far as to show that the angles must have the squares of the cosines rational, and then the special values are given. No attempt is made to show that these are all the possible cases. It is not difficult to find all the submultiples of 180° which satisfy the condition, and the complete solution has long since been worked out by Axel Gadolin and Prof. Maskelyne.

The author is remarkably well read in the literature of crystallography, and has done much to compress the valuable portion of this literature into the space of a comparatively small volume. The book is certainly not suited as a text-book for students who are beginning crystallography; and its methods of solution of crystals are not the simplest in practical work. For advanced students, who wish to regard their subject from different points of view, it will be a suggestive book; and, notwithstanding its omissions, will very greatly assist them, both by its own statements and solutions of the problems of crystallography, but also by its careful references to the literature of the subject. It is well printed, and has a large number of excellent woodcuts.

OUR BOOK SHELF

A Dictionary of Popular Names of the Plants which furnish the Natural and Acquired Wants of Man, in all Matters of Domestic and General Economy; their History, Products, and Uses. By John Smith, A.L.S. (London: Macmillan and Co., 1882.)

THE lengthy and somewhat incoherent title cited above is less expressive of the aim of this volume than the abbreviated form which appears upon its cover—viz. "Dictionary of Economic Plants." Mr. Smith, the veteran ex-curator of Kew Gardens, has brought together a great deal of information with regard to economic plants; and his facts, although sometimes open to criticism if examined in detail, are in the main trustworthy. It is not always easy, however, to reconcile the contents of the volume with its title; interesting as are such plants as the "side-saddle flower" (*Sarracenia*), "telegraph plant" (*Desmodium gyrans*), broom rape, wallflower, Virginian creeper, mignonette, and the like, they can hardly be regarded as supplying either the "natural" or the "acquired wants of man." We have tested the work somewhat carefully, and have in almost every instance found the name we were seeking; and we can therefore say that this Dictionary, although not perhaps particularly needed, may be usefully referred to by those interested in economic botany.

Induction. By Willoughby Smith. 17 pp. (London: Hayman Brothers and Lilly, 1882.)

IN this work Mr. Willoughby Smith gives an account of some curious and interesting experiments on magneto-electric induction as revealed by the Bell telephone. In one of these experiments an intermittent current was sent through a flat spiral coil of wire 36 inches in diameter containing 1220 yards of wire in 800 turns. When an ordinary Bell telephone, unconnected with the circuit, is held within a few feet of this, spiral sounds are heard in it, even if the coil of the telephone be removed, leaving only the iron tympanum and the magnet. Mr. Smith however appears to regard this effect as something not explainable on the ordinary laws of electrical action, and he applies a new term, "specific inductive resistance," to the power of a medium to stop such inductive action. He thus introduces a confusion between two conditions in the case. That such induction should be propagated depends upon the coefficient of magnetic induction, and also depends upon the damping of induction by the setting up of currents in an interposed sheet of metal. Both these causes are perfectly well known. It is a pity that an able experimenter commits himself to crude ideas of this kind. There are several good plates of figures added.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The Mount Pisgah (U.S.) Stone Carvings

PERMIT me to make the following remarks on Dr. Rau's letter in NATURE, vol. xxvi. p. 243. I hope shortly to lay before your readers a statement of the facts relative to the objects under discussion.

At Prof. Baird's request I met him and Dr. Rau at Washington with the carvings and photographs I now have in Europe. These were looked at by Dr. Rau, and he now states as the result that he is "enabled to express an opinion concerning them," and that "they neither show the characteristics of the stone sculptures discovered in the mounds, nor do they resemble the well-known specimens of modern Indian art."

Now if Dr. Rau had compared certain of these objects with some of those found by Squier and Davis in the Scioto mounds, he might probably have "discovered," as I did some time ago, and others have observed since, some resemblance in them. Moreover, there are objects in the collection which may have been, and no doubt were, made by Indians. A striking illustration appears in a very rudely incised stone—photographs of which Dr. Rau saw; an Indian is represented with feathers in his head and a flint-lock gun in his hand. But, notwithstanding the occurrence of this and a few other similarly treated objects, the majority of these carvings do not "resemble the well-known specimens of modern Indian art." In the representations of the

men and women there is a striking and peculiar physiognomy, which is the same in hundreds of the sculptures; there are other traits equally persistent, and the ornamentation—of which there is so much on the figures, tablets, and vases, is unique, and preserves a constant relation. The uniform observance of such characteristics in so large a number of objects, would seem to determine them as "typical," no matter who were the makers of them, or when they were made.

Dr. Rau believes, he says, that the "carvings" originated in comparatively modern times. I should be pleased to have any evidence either from colonial or other history of West North Carolina, that might throw light upon their production, as I have spent much valuable time in endeavouring to find such evidence.

Dr. Rau continues:—"They ('the carvings') were made by a few individuals of the Indian, or, perhaps, even of the Caucasian race." But he has already said that they *do not* "resemble the well-known specimens of modern Indian art." How, then, does he know that "they were made by a few individuals of the Indian race?" And I would ask why members either of the Indian or Caucasian races have chosen to make representations of other peoples than themselves, and with other characteristics than their own? Why Indians, who are notoriously prone to war, should have, in their representations, so carefully absented all of its indications, and emphasised the pleasures and avocations of peace? And again, why—if the "carvings" were made by a Caucasian, the maker has so studiously refrained from placing any letter, sign, or symbol, significant of his race or religion, on any of the 2000 objects?

"The rude attempts at imitating animals of the Old World," proceeds Dr. Rau, "are conclusive evidence that the makers either had seen such animals, or knew at least that they existed." Not necessarily—for they may "be rude attempts at imitating animals" of the New World. The mounds of the United States indicate that an intercourse existed between different tribes and peoples remotely separated; and, why could not peoples, while trafficking to, or emigrating from extreme points, carry with them impressions sufficiently forcible for "rude attempts at imitating," and the peccary, the tapir, and the llama, perhaps have been the models for the production of some of these apparently "Old World animals?"

Dr. Rau objects to "potstone" as a material for endurance, whereas it is found in the mounds in better state of preservation than clay pottery. He has not been made aware, perhaps, that the element of fire has caused much more damage to these carvings than "exposure." He may remember that the "carvings" were coated over with a greasy-looking soot—for their better protection, possibly, as the coating was made to penetrate well into the surface of the stone. Nevertheless, many of them are in a very bad condition. But if there were not well-preserved antiquities—and imitations also—in an admirable state of decrepitude, even in the museums, I conceive that there are more important matters to be considered in connection with these carvings than the material of which they were made.

In conclusion, it is perhaps to be regretted that Dr. Rau has not in his communication suggested any satisfactory explanation of the "curious stone carvings from the neighbourhood of Mount Pisgah, and that he leaves the subject with such dubious language as 'modern intrusion.'" MANN S. VALENTINE

Paris, July 17

Movable Coils

MR. E. OBACH's letter contains information which I am much pleased to obtain. Besides Messrs. Siemens' use of fine aluminium wire for a relay, Mr. Varley stated that it had been tried by his brother or himself for the moving coil of a syphon recorder, but without notable advantage over gold. With such currents as would be available in these two cases, no doubt slight variations in resistance would be of the utmost detriment. With the small but high-tension currents of an induction-coil, the case is materially different; whereas the lightness of the moving coil, as I endeavoured to show, enables currents "of moderate intensity" to be appreciated.

The resistance of 1 metre of copper wire 1 millim. in diameter is given in Sabine's tables as 1·06 as compared with silver, and that of aluminium 1·94. I find the the weight of the two to be respectively 2·7 and 0·99 grammes. This is, of course, when both are silk-covered. The ratio between the densities of pure copper and aluminium is 3·44. The silk covering lessens the aggregate weight of the copper, and increases that of the aluminium, so that the ratio becomes 2·72.

It is, however, obvious that, weight for weight, aluminium will carry much more electricity than copper.

The junctions of gold and aluminium have hitherto given no trouble, nor has the total resistance of the little dynamometer altered; though it has had a double railway journey, partly in third class, of about 120 miles. W. H. STONE

14, Dean's Yard, Westminster, S.W., July 15

The Analysis of the Tuning Fork

WITH reference to the letter of Mr. Stanley in NATURE, vol. xxvi. p. 243, I notice the following sentence:—"If we may apply this principle to stringed instruments, we must look rather to the bridge than the transverse motion of the string, as the communicator of the sonorous vibrations which produces the note." I thought that this was an admitted fact. Upon the shape of the bridge depends the tone of the instrument, as was satisfactorily settled by Stradivari. The bridge is usually made of spotted maple, and its thickness is of the greatest importance, for if it is too thick it will fail to respond to the string vibration. A plain piece of wood as a bridge is absolutely useless, and the tone increases as the proper shape is approximated to.

Rugby, July 14 GEORGE RAYLEIGH VICARS

The Chemistry of the Planté and Faure Cells

I HAVE read with much interest the important researches of Dr. Gladstone and Mr. Tribe into the chemistry of lead secondary batteries, and my own experience has been in general very confirmatory of their conclusions; but I am in a difficulty concerning one point in their third article, which appeared in your last issue, and I should be glad to be allowed to ask a question.

The conclusion that during discharge the reduced spongy lead is changed to sulphate of lead is, no doubt, the natural one, and it appears to be confirmed by the analysis of Messrs. Gladstone and Tribe; but then, if this is the sole product, how is the cell able to be recharged? For I find that if the plates are spread originally with $PbSO_4$, instead of with minium, it is scarcely possible to charge the cell. The coating to be oxidised will indeed allow itself to be acted on very slowly, but the coating to be reduced remains perfectly unchanged. This led me to suppose that the sulphate formed on discharging a cell was perhaps so intimately mixed with some oxide that the reducing action could as easily go on as at the first formation of the cell. But this hypothesis scarcely seems borne out by Messrs. Gladstone and Tribe's results; for though a good deal of unaltered peroxide is found after discharge on the one plate, yet on the other they speak of sulphate as being ultimately the sole product of the discharge. It may be that they used a large excess or acid in their cells, but if so, it would be interesting to know whether either of the discharged plates refused to charge up again.

I doubt very much whether, in the cells of commerce, there is anything like enough acid present to combine with all the lead, and I think that in these a great part of the spongy lead would have to be content to oxidise itself somewhat and so remain ready to be reduced again when the charging current is applied. I by no means deny that sulphate mixed with other things can be acted on, but I do find that it is reduced with some difficulty, and when by itself not at all.

I hope, however, that my question may be the means of eliciting further information from the more extensive experience of Messrs. Gladstone and Tribe. OLIVER J. LODGE

University College, Liverpool, July 14

A Curious "Halo"

I TAKE the liberty of communicating an observation made on Saturday evening last between 8 o'clock p.m. and 8·15 p.m. of a sort of halo which appeared in the east-south-east, just over Killiney Hill. Near the horizon was a bank of heavy, slate-gray clouds coming up from the south, and from behind rose up a principal beam from the Telegraph Hill, Killiney, with two side beams of lesser intensity on the sides, at angles of about 28°–30° were lesser beams diverging from the common centre.

All those beams were *dark*, or appeared so against the sky. I mention the appearance, as the weather since has been singularly cold and rainy for the season. J. P. O'REILLY

Royal College of Science for Ireland, Stephen's Green, Dublin, July 17

THE TRANSIT OF VENUS

WE have received the following list of selected stations for the observation of the coming transit of Venus, with the observers appointed to each, according to the arrangements, so far definitive, made by the executive committee of the Royal Society acting under the authority of the Treasury, and also the instructions prepared for the guidance of the observers.

For Retarded Ingress and Accelerated Egress

Jamaica—Dr. Copeland, Capt. Mackinlay, R.A., Mr. Maxwell Hall.

Barbados—Mr. Talmage, Lieut. Thomson, R.A.

Bermuda—Mr. J. Plummer, Lieut. Neate, R.N.

(The Canadian Government will have three observers with six-inch instruments, besides others with smaller telescopes. These observers are acting in direct concert with the British Expeditions).

Accelerated Ingress

Cape Observatory—Mr. David Gill (H.M. Astronomer), Mr. Maclear, 2nd assistant.

Montague Road, Cape Colony—Mr. W. H. Finlay (1st assistant at the Cape), Mr. Pett.

Aberdeen Road, Cape Colony—Mr. Burton, Mr. C. M. Stevens.

Madagascar—Father Perry, Father Sidgreaves, Mr. Carlisle.

Durban, Natal—A telescope has been provided by the colonists.

Mauritius—Mr. Meldrum.

Retarded Egress

New Zealand—Lieut.-Col. Tupman, R.M.A., Lieut. Coke, R.N.

Brisbane—Capt. Morris, R.E., Lieut. Darwin, R.E., Mr. Peek.

Melbourne—Mr. Ellery and staff.

Sydney—Mr. Russell and staff.

Instructions to Observers

The "Instructions issued by the International Conference on the Transit of Venus, 1882," are recommended for general adoption. These instructions are, in a great measure, founded upon "Suggestions for a Draft of Instructions for the Observers," which the English Committee circulated for consideration in October, 1881. But as copies of the Instructions, issued by the International Conference, may not reach observers in the English colonies who may be willing and able to co-operate effectively, and as there are some additional explanations and cautions which the English Committee consider it desirable to give their observers, the following instructions have been issued. It is most earnestly hoped that all observers who are able to co-operate effectively in the observation of contacts will, whatever else they may observe, observe the *contacts as defined*; and that they will employ sufficient magnifying powers on their telescopes and use a field of view of moderate brightness. These are essentials, if their observations are to be combined with the results of the English expeditions.

1. It is most important that the apertures of the refractors used for the observations of the contacts should be nearly equal. The apertures of the telescopes available for the English expeditions are not generally larger than six inches; and it is therefore recommended that observers with larger apertures should stop them down to six inches, but not reduce them below that size. It is considered that perfect instruments of four inches aperture may give results sufficiently comparable with those made with the six-inch telescopes to allow all the observations to be combined in one common discussion; and it is hoped that observations with such instruments will be made. Observations with good instruments of smaller apertures than four inches will be exceedingly valuable for combination with others made with instruments of the same class, provided that powers of 100 to 150 can be employed on them. Observations of contact made with very *low powers* are useless for the objects in view. When reflectors are used, apertures should not be less than seven inches.

2. The observers are requested to furnish tests of the optical performances of their telescopes, such as—

(1) The appearances presented by the disc of a bright star when the eye-piece is pushed within and pulled without the focus.

(2) The power of the telescope to separate some well-known close double stars.

(3) Whether the observer was able to see the "rice grains" or "granulations" on the sun's disc on the day of the transit and if not, whether he is generally able to see them with the same instrument and a power of 150 on days of good definition.

3. The observers are recommended to employ a first-surface reflecting prism to diminish the sun's heat and danger to the observer's eye, and a compensated neutral-tint wedge *between the eye-piece and the eye.*

4. The eye-pieces recommended are the "negative," or a "Steinheil's simple achromatic positive eye-piece." When the latter is used, two pairs of very fine parallel wires should be placed on opposite sides of the field of view at distances corresponding to a second of arc apart. Such wires are useful in judging of the brightness of the field of view, and of the sufficiency of the optical power employed to subdivide a second of arc into tenths, and in estimating the angular separation of the limbs in descriptions of any phenomena which may be seen near the contact.

5. All attempts to observe the contacts with double-image eye-pieces are to be avoided.

6. The use of Dawes' solar eye-piece is not recommended. This eye-piece is exceedingly valuable for the examination of small detached portions of the solar disc; but the field of view is very limited, and, if clouds were passing, there would be practical difficulties in keeping the point of contact exactly in the centre of the field, whilst the effects of the stop would certainly be injurious to the contact observations near the edge of the field.

7. The magnifying power should be about 150, and, even if the definition is not good, this power should not be much reduced. It is essential that the observer should be able to subdivide a second of arc into tenths, and to do this a high power is necessary.

8. It is extremely desirable that all the observations of contact should be made in fields of view of nearly the same brightness, and the illumination should neither be one of extreme brightness, which greatly complicates the phenomena seen near the contacts from the increased effects of irradiation, nor one so faint that difficulties may be experienced in distinguishing changes in the illumination of the sun's limb near the point of contact, which can only be recognised by contrast. If pairs of very fine spider webs are placed at a distance corresponding to a second of arc in the focus of a positive eye-piece, they may be used for the determination of a suitable illumination of the field of view by observing at what part of the neutral-tint wedge the wires can just be seen with sufficient distinctness to allow the observer, without difficulty, to sub divide the interval between them into tenths; but in the application of the test the wedge must be shifted quickly, and the eye not allowed to strain itself in attempting to separate the wires, or a too dull field of view will be secured. The test is a delicate one to apply, and it is probably better to replace it in practice by the following:—When the sun is free from clouds, determine with what parts of the neutral-tint wedge the sun's limb can just be observed with comfort, and with what part of the wedge the limb can just be distinctly and clearly seen. A mean portion of the wedge between these extremes should be adopted as a standard field of brightness with a clear sun; and this degree of brightness, learnt by practice as a habit of the eye, should be adopted for the brightness of the field of view in the observation of the contacts.

9. The expressions "contact," "apparent contact," "actual contact," "real contact," and "true contact," appended to time records without any explanation of the sense in which the word "contact" is used, are liable to be misunderstood. Such expressions should not, therefore, be employed, unless a description of the particular kind of contact referred to is appended.

10. The phenomena seen, by most observers, near the time of contact, in a moderately bright field of view, are of a complex character, and extend over considerable intervals of time. It is therefore necessary to direct the attention of the observers to some *distinctive* phases which all those, who have sufficient optical means, should certainly see unless prevented by clouds. Subject to the remarks *a*, *b*, *c*, *d*, the times to be recorded near the internal contacts are as follows:—

At Ingress.—"The time of the last appearance of any well-marked and persistent discontinuity in the illumination of the apparent limb of the sun near the point of contact."

At Egress.—"The time of the first appearance of any well-marked and persistent discontinuity in the illumination of the apparent limb of the sun near the point of contact."

(*a*) The expression "*well-marked* and *persistent* discontinuity

in the illumination of the apparent limb of the sun near the point of contact" is intended to guard observers against giving times for the contacts when there may be a *suspicion* only of some slight disturbance, haze, shadow, or interference phenomena. It is a point of primary importance that all the observers shall, as far as possible, observe the same kind of contact; and it is therefore desirable that the times recorded for contacts should refer to some marked discontinuity in the illumination of the sun's limb, about which there cannot be a doubt, and which may be supposed to be recognisable by all the observers.

(*b*.) If a pure geometrical contact, "contact géométrique sans déformation," is alone seen, this is the only time which can be given for the contact; but if haze, shadow, ligament, or black drop is seen, then the last time, when any marked discontinuity in the illumination of the sun's limb near the point of contact is distinctly recognised as *independent of mere atmospheric tremor*, is a time which should be recorded at ingress; and the first time at which such a marked discontinuity in the illumination is certain, is a time which should be recorded at egress. But if the haze, shadow, ligament, or black drop is ever seen as dark, or nearly as dark, as the outer edge of the planet, the time of greatest blackness, when it is last seen at ingress, or first seen at egress, as dark or nearly as dark as the outer edge of the planet, is also to be most carefully recorded; this phase appears to correspond most nearly to what is given by some observers as "contact géométrique sans déformation," and probably differs but little from what most observers would call "contact," if restricted to a single phase. Near the time of contact the attention of the observer should be directed to the parts of the sun's limb near the point of contact. The discontinuity of the illumination of the sun's limb near the point of contact will be recognised by the contrast between the illumination *at* and *on each side* of the point of contact.

(*c*) At ingress the contact can also be regarded as the time "when light is about to glimmer all across the dark space between the cusps." For so long as the sunlight has not "glimmered" across the dark space between the cusps, there must be "some well-marked and persistent discontinuity in the illumination of the sun's limb near the point of contact." In this definition the attention of the observer is directed to the light of the cusps which is encroaching upon the "dark space" between them, whilst in the definition adopted in these instructions his attention is directed to the disappearance of the dark space between the cusps which is being encroached upon by the light of the cusps. Great care is, however, required when the contact is thus regarded, that the glimmering of the light of the "auréole," "penumbra," or "sunlight refracted through the atmosphere of Venus," across the dark space between the cusps be not taken for the contact. The time thus recorded would be earlier than the contact required by about a minute of time. On the other hand, a time must not be given "when sunlight is distinctly recognised" between the limbs without any direct reference to the time when the dark space between the cusps was last recognised.

(*d*) The observer should clearly and distinctly indicate the times which, in his opinion, correspond most nearly to the contacts as defined above. But in cases where he has any doubt about the second of time which ought to be given, on account of the gradual obliteration and restoration of the illumination of the sun's limb near the point of contact, or on account of any change in the degree of darkness in the haze seen, he may give two times, with a clear intimation of his inability to say which of the two corresponds most nearly to the time of contact; and such observations, if the limits of uncertainty are confined within a few seconds, will be amongst the most satisfactory observations which can be made. The observer must not be discouraged from giving the nearest second possible on account of the lingering character of the contact. The *change in the angular* separation of the limbs of Venus and the sun is only a tenth of a second of arc in about two seconds of time. It is with seconds of arc, and not seconds of time, that we are ultimately concerned; and one tenth of a second of arc is a very small quantity to be measured on the sun's limb. In the Transit of 1874, when, however, the change in the angular separation was much slower than in 1882, many observers were discouraged and disappointed at the degree of accuracy attainable, and the observations appear to have suffered from a feeling on the part of the observers that such observations as they could make were worthless. This feeling should be carefully guarded against.

11. It is hoped that all the observers may be able to observe contacts as defined; but should an observer see a contact which, in his opinion, does not agree with the definition, he must record the time of contact, and describe the nature of the contact observed, with drawings to illustrate his meaning. It is desirable that an observer should record the times at which any *very distinctive* phenomena are first or last seen near the contacts. But the multiplication of *unnecessary* time records near the contacts is, in itself, a serious evil, and should be carefully guarded against; and, more particularly, records of time corresponding to "clear sunlight between the limbs of Venus and the Sun" are to be avoided after all touch, as shown by some recognisable disturbance of the illumination of the sun's limb near the point of contact, has ceased at Ingress between the limbs of Venus and the sun. When this touch has once ceased, all subsequent records of time, unless accompanied by direct measurements of the angular separation of the limbs at these times, afford no possible means of determining the angular separation of the centres of the sun and Venus. Such records are, therefore, of no direct value; but unless great care is taken they may be accepted as referring to contacts, and may thus lead to most serious error.

Attention to this point is more particularly necessary when observations of the contacts are picked up through clouds. If, therefore, times are recorded at "ingress" for "distinct band of light between the edge of Venus and the sun's limb" or "Venus well on the sun's disc," the observer must most distinctly state whether this time record is intended to mean that the haze, shadow, ligament, or black-drop was certainly seen within a few seconds, at most five, of the recorded time, or whether it is intended merely to state as an isolated fact that the contact was over at the time recorded. Time records of the first class are valuable, but those of the latter class are useless, and may be misleading.

12. If the limbs of Venus, at internal contact, as defined in 10, fall within the sun's disc, then the observer should give, as accurately as he is able, probably to seven or eight seconds, the time at which the limbs of Venus and those of the sun mentally completed would appear to touch. This observation must be a rough one; but it is desirable in the case indicated to give it as a check upon the principal phase observed.

13. External contacts should be observed. The value of the external and apparent contacts, which are referred to the "visible" or "apparent" limb of the sun, will greatly depend upon the extent to which uniformity in the instrumental equipments, and in the brightness of the fields of view, may have been secured.

14. It is desirable that all observers who have double-image micrometers should measure the cusps at egress, and the distances between the limbs of the sun and Venus after internal contact at ingress; but the eye-pieces should not be changed at ingress until there is a broad band of sunlight between the limbs of Venus and the sun. If an observer feels perfectly confident in his ability to change the double-image micrometer for an ordinary eye-piece and to focus properly, after making cusp measures, before internal contact at ingress, then such an observer may venture to make cusp measures at ingress; but it is most earnestly hoped that observers will not run any risk of losing the internal contact observations at ingress for the sake of these cusp measures. It is necessary, not only for the eye-pieces to be changed and the focus found, but that time should be allowed for the eye to accommodate itself to the new eye-piece before the internal contact takes place, or satisfactory observations of internal contact will not be made.

15. In all cases the recorded times should be those taken directly from the chronometer or clock used.

16. The maker's name and number of the chronometer or clock used should be given.

17. The errors of the chronometers and clocks should be given for a few days before and after the transit, and a clear statement made of how these errors have been determined. Chronometers should be compared, whenever possible, before and after the transit with some standard clock.

18. The greatest care should be taken to insure the accuracy of the entries of times from the clocks and chronometers used in the contact observations, and unusual care is required in the verification of the *minutes* and the *half-minutes*. In most astronomical observations, if the seconds are recorded correctly,

the minutes can be supplied with perfect certainty by calculation; but in observations of a transit of Venus the contacts from apparent contact to the "last appearance of any marked "disturbance of the illumination" may, in a moderately bright field, extend over more than a minute of time; and if any misconception of the kind of contact which has been observed should be possible from ambiguity in the description given by the observer, then a serious error may be introduced into the discussion of the results from the adoption of a wrong minute and wrong kind of contact for this observation. In the use of chronometers mistakes of half a minute have occasionally been made by taking the "arrow end" instead of the "*longer* end" of the seconds hand.

In all cases, therefore, such precautions should be taken to verify the minutes and half-minutes that errors of entry can be asserted to be impossible.

19. Approximate latitudes and longitudes of the station, and the authorities from which they are derived, should in all cases be given, together with the local names of the station.

20. The position of the observer should be permanently marked, and, if possible, referred to three or more surrounding natural objects, as mountains, so that the position can be recovered if the mark should be accidentally destroyed.

21. In cases where the errors of the chronometers or clocks and the geographical position of the observers are independently determined, the observations upon which these determinations rest should be given.

22. The descriptions of the contacts which correspond to the time records should be written out by each observer, and entered in an indelible form, before any discussion or comparison of the observations with those made by any other observer has been made. On no account is a written figure to be altered. On no account is a new figure to be written upon an old one. Any correction is to be written on another line, and attested by the signature of the observer.

23. Copies of these observations, authenticated by the signature of the observer, with the necessary materials for the determination of clock-errors, longitudes, and latitudes, should be forwarded by the next or following mail to the Committee at the Royal Society, Burlington House, London. In the case of the Government expeditions, the original documents must be placed in the hands of the official in charge of the Treasury chest at the station, by whom the originals will be retained until the Committee have acknowledged the receipt of the copies and forwarded instructions for the despatch of the originals.

24. Practice with the artificial models of the transit will be useful to observers as a preparation for the slowness with which changes in the appearances presented near the internal contacts take place. But the exact phases presented in the real transit cannot at present be reproduced in the models, and, unless care is taken, model practice may do more harm than good in leading observers to expect a definite succession of phenomena near the internal contacts which they may be unable to recognise in the actual transit. The complicated phenomena presented near the internal contacts are, no doubt, chiefly due to diffractional irradiation; but in the case of the models we have the sun and Venus bounded by hard edges. The diffraction phenomena beyond the geometrical boundary of the artificial sun, and the interference phenomena between the limbs of the sun and Venus, are continually changing as the disc, which represents Venus, approaches nearer and nearer the hard edge which represents the geometrical boundary of the sun's disc. These conditions introduce complications into the phenomena seen with the model which have nothing exactly corresponding to them in the real transit; whilst, on the other hand, the presence of the partial illumination of the atmosphere of Venus introduces difficulties in the observation of the real transit which have nothing exactly corresponding to them in the models in ordinary use.

ATOMIC WEIGHTS[1]

SEVEN years after the publication of the first volume of Dalton's "New System of Chemical Philosophy," and therefore at a time when the data from which atomic weights could be deduced were few and inaccurate, Prout promulgated the hypothesis that the atomic weights of all the elements are multiples of that of hydrogen.

This hypothesis was soon shown to be without foundation in fact, but in the modified form given to it by Dumas—viz. the atomic weights of all the elements are whole, half, or quarter multiples of that of hydrogen—it found very considerable acceptance among chemists, although it was strongly opposed by many.

In 1860 Stas published the results of very carefully-made determinations of the atomic weights of nitrogen, chlorine, sulphur, potassium, sodium, lead, and silver. Stas concluded from these results that Prout's hypothesis is purely imaginary; that each elementary substance is a distinct entity, and exhibits no simple mass relations with other elements.

Marignac criticised the numbers obtained by Stas, objecting that unless an atomic weight is determined by wholly different series of experiments it cannot be accepted as final, and making the somewhat astonishing statement that possibly the composition of a given compound is not altogether invariable. The reply of Stas appeared in the form of his famous "Nouvelles recherches sur les lois des proportions chimiques, sur les poids atomiques et leur rapports mutuels," wherein the fixity of composition of many compounds was firmly established, and numbers were deduced, from widely different and most carefully conducted series of experiments, for the atomic weights of silver, iodine, bromine, chlorine, sulphur, nitrogen, lithium, potassium, sodium, and lead, which numbers appeared finally to negative the hypothesis of Prout, even in the form given to it by Dumas.

The experimental work of Stas has been accepted as unimpeachable by every chemist. The "Nouvelles recherches" is a classical work. But in 1878 Dumas showed that pure silver, prepared by the method adopted by Stas, gave up weighable quantities of oxygen when heated in vacuo. The numbers given by Stas as the atomic weights of the elements enumerated above may therefore not represent the true atomic weights of these elements. The importance of the discovery made by Dumas is emphasised when we know that the atomic weight of silver is a fundamental number, on which most of the other atomic weights determined by Stas depend.

In 1872, Crookes communicated to the Royal Society the results of an extremely careful determination of the atomic weight of thallium; the mean number obtained, 203·642, was regarded by Crookes as strongly against Prout's hypothesis.

Recent work, physical as well as chemical, has again caused attention to be turned to the hypothesis which would regard the elements as forms of one kind of matter.

The necessity for a revision of many atomic weights has impressed itself on chemists; and several very careful revisions, notably that of the atomic weight of antimony by Cooke, and of aluminium by Mallet, have recently been made. But in addition to these new data there exist many determinations, which, if properly collected and digested, would be of much importance. Prof. Clarke has done this most admirable service to science.

"Atomic Weight Determinations; a Digest of Investigations published since 1814," by Prof. G. T. Becker, has already appeared as Part iv. of the Smithsonian *Constants of Nature;* Prof. Clarke's *Recalculation* completes the *Digest;* together these form a contribution to chemical science of the first importance.

The ratio between the atomic weights of oxygen and hydrogen is that first discussed. Each series of experiments is considered separately; the mean value is found and the probable error of this mean is assigned by the method of least squares. Those elements, the atomic weights of which have been most carefully determined, viz. silver, chlorine, bromine, iodine, potassium, sodium, and sulphur, are next considered.

The discussion of atomic weights involves many chemi-

[1] "The Constants of Nature. Part V. A Recalculation of the Atomic Weights." By Frank Wigglesworth Clarke, S.B., Professor of Chemistry and Physics in the University of Cincinnati. (Washington: Smithsonian Institution, 1882.)

cal considerations: more or less weight must be given to different results on other than purely mathematical grounds; hence identical final results would not always be arrived at by different calculators starting from the same experimental data. Inasmuch as "the atomic weight of each element involves the probable error of all the other elements to which it is directly or indirectly referred," it may happen that the probable error attaching to an atomic weight determination is large, although the experimental data are extremely accurate. Thus, Crookes, by very accurate experiments, found the atomic weight of thallium to be 203·642; but this number supposes that $NO_3 = 61·889$; the value to be now assigned to the atomic weight of thallium depends on the accuracy with which the atomic weights of oxygen and nitrogen have been determined. The work of Crookes simply fixes, with great accuracy, the ratio between the equivalents of Tl and NO_3.

The most probable value for the atomic weight of oxygen is found to be 15·9633 (H = 1), with a probable error of ± ·0035; any error which there may be in this determination is involved in the determinations of the atomic weights of most of those elements which come after oxygen. When the atomic weight is large, the error thus introduced may be considerable: thus if O = 15·9633 Ur = 238·482, but if O = 16·00 Ur = 239·03; difference = 0·548.

Some of the weighings involved in the calculations have been reduced to absolute standards, others are only uncorrected weighings in air; hence an error is sometimes introduced which cannot be eliminated.

The discovery of Dumas that silver prepared by the method of Stas, occludes weighable quantities of oxygen, has been already referred to; in four experiments Dumas found that 1 kilogram of silver occluded 82, 226, 140, and 249 milligrams of oxygen respectively; the largest of these numbers is taken by Prof. Clarke as "Dumas' correction." The effect of applying this correction is generally very slightly to lower the value of the atomic weight; the following table exhibits this effect in a few instances:—

	Uncorrected.	Corrected.	Difference.
Silver ...	107·923	107·896	− ·027
Chlorine ...	35·451	35·478	+ ·027
Bromine ...	79·751	79·978	+ ·027
Iodine ...	126·848	126·875	+ ·027
Potassium ...	39·109	39·083	− ·026
Sodium ...	23·051	23·024	− ·027

In the appendix is given a table containing the mean atomic weights (with probable errors attached) for all the elements, calculated from the most trustworthy data. It is shown that twenty-five out of the sixty-six elements considered have atomic weights the values of which differ by less than one-tenth of a unit from whole numbers, (H = 1) but many of those numbers which differ by more than this fraction involve any error which there may be in the determination of the value of the atomic weight of oxygen, multiplied many times. If the possible error in the value for oxygen be transferred to that for hydrogen, *i.e.* of O = 16, then it is shown that forty-four out of the sixty-six elements have atomic weights differing by less than one-tenth of a unit from whole numbers. Of these forty-four elements, twenty-six show plus, and thirteen minus variations from whole numbers. Those which exhibit minus variations are discussed in detail; the values for the atomic weights of seven of these have not been determined with any great accuracy; silver alone has a value which carries "very much weight against the hypothesis of Prout." Of those elements, twenty-six in number, the atomic weights of which exhibit plus variations (less than 0·1) from whole numbers, three—viz. Nb, Yt, and Ur—have values which have been very inaccurately determined; seven involve "Dumas' correction," the application of which will bring the values nearer whole numbers (Al, As, Ba, Cd, Li, P, and Na). Special sources of possible error are indicated in the discussion of the atomic weights of Al, Ca, F. Five, of the twenty-six elements, have atomic weights the values of which involve errors due to the possible occlusion of hydrogen by the metals when reduced from their compounds (Co, Fe, Ir, Ni, and W). In many other cases the variations from whole numbers are extremely small, *i.e.* much less than one-tenth of a unit. "In short in the majority of instances the errors may be diminished by corrections which are in all probability needed, and which we can easily point out."

Twenty-six elements have atomic weights the values of which vary more than one-tenth of a unit from whole numbers; of these twenty-six, three—viz. Cl, Rb, and Sr have values nearly half multiples of that of hydrogen; the atomic weights of nine—viz. Sr, Au, In, La, Rh, Ru, Si, Te, and Zr—have been very imperfectly determined; the atomic weights of Sb, Ce, Be, Yt, Pt, and Hg are discussed, and it is shown that the atomic weights of these elements *may* come within Prout's hypothesis; no criticism is offered on the atomic weights of Cr (52·129 ± ·025), Cu (63·318 ± ·011), Mo (95·747 ± ·051), and V (51·373 ± ·024).

The value to be assigned to iodine (126·848 ± ·022) depends on that for silver; at present iodine stands as an important exception to Prout's rule. Potassium presents a serious objection; but if "Dumas' correction" is applied K becomes 39·083 [O = 16]. Clarke concludes by saying that although he began his examination of atomic weights strongly prejudiced against Prout's hypothesis, the facts have obliged him to give it "a very respectful consideration." "All chemists must at least admit that the strife over it is not yet ended, and that its opponents cannot thus far claim a perfect victory."

The recalculation of atomic weights shows clearly to the chemist what experimental work ought now to be undertaken; revisions of the atomic weights of tellurium, silicon, boron, mercury, chromium, manganese, uranium, and gold are urgently called for. The "periodic law" requires that the atomic weight of tellurium should be smaller than that of iodine; although the mean number recently obtained by Wills is greater than 127, yet this number cannot be accepted as final. Several results brought out by Clarke have an important bearing on the "periodic law." In most of the tables of elements arranged in accordance with the law, didymium is placed before cerium and lanthanum; Clarke however shows that Di = 144·573 (± ·031); Ce = 140·424 (± ·017); and La = 138·526 (± ·03). Brauner, in his paper recently published in *Chem. Soc. Journal*, finds Di = 146·18 (mean of three results), and La = 139·58 (mean of two results). We may therefore conclude that La < Ce < Di. These elements then come in series 8; lanthanum in group III. giving the characteristic oxide La_2O_3, cerium in group IV. giving the oxide Ce_2O_4, and didymium in group V. with the oxide Di_2O_5, which oxide has been lately prepared and examined by Brauner (*Chem. Soc. Jnl. Trans.*, 1882, p. 68).

Prof. Clarke's work may be taken as a type of what is now so much wanted in chemistry: a careful collection and digestion of masses of facts. We seem to be forgetting that chemistry is a science, not a collection of facts. Every week adds fresh material to the heap; the science is in danger of being crushed beneath the load of details.

M. M. PATTISON MUIR

FIRE RISKS FROM ELECTRIC LIGHTING

A VERY strong and influential committee was recently formed by the Society of Electricians to draw up a series of rules and regulations not only for the guidance and instruction of those who have electric lighting apparatus installed on their premises, but for the reduction to

a minimum of those risks of fire which are inherent to every system of artificial illumination. They point out that the chief dangers of every new application of electricity arise mainly from ignorance and inexperience on the part of those who supply and fit up the requisite plant.

The difficulties that beset the electrical engineer are chiefly internal and invisible, and they can only be effectually guarded against by "testing" or probing with electric currents. They depend chiefly on leakage, undue resistance in the conductor, and bad joints, which lead to waste of energy and the production of heat. These defects can only be detected by measuring, by means of special apparatus, the currents that are either ordinarily or for the purpose of testing, passed through the circuit. Bare or exposed conductors should always be within visual inspection, since the accidental falling on to, or the thoughtless placing of other conducting bodies upon such conductors might lead to "short circuiting" or the sudden generation of heat due to a powerful current of electricity in conductors too small to carry it.

The Committee point out that it cannot be too strongly urged that amongst the chief enemies to be guarded against are the presence of moisture and the use of "earth" as part of the circuit. Moisture leads to loss of current and to the destruction of the conductor by electrolytic corrosion, and the injudicious use of "earth" as a part of the circuit tends to magnify every other source of difficulty and danger.

The chief element of safety is the employment of skilled and experienced electricians to supervise the work.

The rules deal with the installation of the dynamo-machine, the fixture of the wires, the character of the lamps to be used, and the danger that accrues to the person.

To secure persons from danger inside buildings, it is essential so to arrange the conductors and fittings, that no one can be exposed to the shocks of alternating currents exceeding 60 volts; and that there should never be a difference of potential of more than 200 volts between any two points in the same room.

If the difference of potential within any house exceeds 200 volts, whether the source of electricity be external or internal, the house should be provided outside with a "switch," so arranged that the supply of electricity can be at once cut off.

The rules are very valuable, and should be obtained by all those who are contemplating the use of the electric light.

PROF. HAECKEL IN CEYLON[1]

II.

In the July number of the *Deutsche Rundschau*, Prof. Haeckel gives a further account of his stay in Ceylon, a stay which his ardent enthusiasm and unwearied industry cannot fail to have made fruitful in results to the scientific world. The present series of papers being intended for magazine readers in general, is, as might be expected, altogether popular in tone. The Professor's researches and discoveries in support of the theory of Evolution, are only implied, not described in detail. His letter is written from the point of view of an intelligent and cultivated traveller, fully alive to the novelty and beauty of the scenes in which he found himself, and of a naturalist anxious to make the most of his very limited time to become familiar with the fauna and flora of that lovely island which Buddhist poets gracefully apostrophise as "a pearl on the brow of India." The energetic Professor was evidently a subject of much wonder to the languid Anglo-Indians and lazy Singhalese, as, in his white linen suit and "Sola" hat, he braved the mid-day sun and even occasionally the tropical rains, besides setting at nought the bites of countless leeches and the stings of mosquitoes and scorpions, and prosecuted his researches from morning till night. It is, however, to this constant bodily exercise and to his invariably temperate diet, that Prof. Haeckel ascribes his perfect health while on the island; but it is doubtful whether, as the body became enervated by the climate, such habits could be long sustained.

[1] Continued from p. 256.

The first, and one of the most delightful excursions made by Prof. Haeckel in Ceylon, consisted in a visit to a Singhalese village called Kaduwella, situated on the left (southern) bank of the Kalany, about ten miles from Colombo. The party from Whist Bungalow, joined by their fellow countrymen residing at the neighbouring Elie House (formerly the residence of Sir J. Emerson Tennent) drove to the appointed place in the little one-horse carriages universal in Ceylon, which are drawn by brisk Burmese ponies, whose speed is superior to their staying powers, ten miles being quite sufficient to tire them out. Horses are rarely used in Ceylon, except in spring carriages, and are almost all imported from the Indian mainland, or from Australia; European horses cannot survive the climate. Bullocks may be said to be the only animals of draught or burden, and Prof. Haeckel mentions the long string of bullock carts, some single, some double, which are constantly met on the road; "the bullocks all belong to the class of the Zebu or humped oxen of India (*Bos indicus*), but there are many varieties; one of the smaller kinds is very swift and agile."[1]

Prof. Haeckel notes as among the most beautiful effects of the Ceylonese lowlands through which the road to Kaduwella lies, the middle place which they occupy between garden and forest, between cultivated and uncultivated nature." Surrounded by majestic trees, all overhung and overgrown with creepers and climbers, one might often imagine oneself in the midst of the wildest forest; but a little hut almost hidden beneath a bread-fruit tree, a dog or a pig issuing from the brushwood, children playing hide and seek behind the caladium leaves, serve to remind us that we are in fact in a Ceylonese garden. The real forest, on the other hand, which is closely adjacent, with its manifold juxtaposition of every variety of tropical trees, with its orchids, cloves, lilies, malvaceæ, and other lovely flowering plants, shows all the variety and apparent design of a costly pleasure garden. This singular mixture of nature and culture is visible also in the human accessories of these forest-gardens; for so great is the simplicity of the dwellings and the clothing of the Singhalese inhabiting them, that although the descendants of an old and cultivated race, there is little in their appearance to distinguish them from mere savages." Arrived at Kaduwella, after a halt and refreshment at the Rest-house (the government substitute for hotels, which are altogether wanting in Ceylon except in the chief towns), Prof. Haeckel made his first attempt to penetrate an Indian jungle, with what success his own words must tell: "The jungle is not, properly speaking, 'primeval forest,' forest, that is, untrodden by the foot of man (such are in Ceylon of small extent and rare occurrence); but it corresponds to our idea of such a forest in that it consists of a dense and impenetrable mass of mighty trees of all kinds, which have sprung up without regularity or any interference from man, and are surrounded and overgrown by a wilderness of creeping and climbing plants, of ferns, orchids, and other parasites, the interstices being so completely filled up with a motley mass of smaller weeds that it is quite impossible to disentangle the coil of tendrils so as to distinguish one species from the other. My first attempt to penetrate such a jungle as this was sufficient to convince me of the impossibility of the undertaking except with the aid of axe and fire. A hard hour's work brought me only a few steps into the thicket,

[1] A pair of these little bullocks carry up about twenty bushels of rice to the hills, and bring down from fifty to sixty bushels of coffee to Colombo. (Sir J. E. Tennent's "Nat. Hist. of Ceylon," p. 52.)

and then I was obliged to acknowledge myself vanquished and make good a retreat, stung by mosquitoes, bitten by ants, with torn clothes, and arms and legs bleeding from the thorns and prickles with which the climbing palm (*Calamus*), the climbing Hibiscus, the Euphorbia, and a multitude of other jungle plants repulse every attack made on their impenetrable labyrinth. But the attempt had not been made altogether in vain, for it enabled me to gain a very fair idea of the jungle as a whole, more especially of the magnificence of its trees and creepers, besides introducing me to many separate varieties of animal and vegetable life, which were of the highest interest; here I saw the magnificent *Gloriosa superba*, the poisonous climbing lily of Ceylon, with its red and amber flowers; the prickly *Hibiscus radiatus*, with large cup-shaped brimstone-coloured flowers, deepening to violet in the hollow; while round them fluttered gigantic black butterflies with blood-red spots on their tail-shaped wings, and chafers and dragon-flies flew past with a metallic gleam. But my delight reached its height when on this, my first attempt to penetrate a jungle in Ceylon, I came across the two most characteristic of its inhabitants from among the higher class of animals—parrots and apes. A flock of green parrots flew screeching from a lofty tree, as they became aware of the gun in my hand, and at the same moment a herd of great black apes sprang with a growling cry into the thicket. I did not succeed in getting a shot at either one or the other; they appeared to be too familiar with the look of a gun. I was consoled, however, by securing with my first shot a colossal lizard or iguana six feet long, of a kind held in much awe by the superstitious natives (*Hydrosaurus salvator*). The huge crocodile-like beast was sunning himself on the edge of a water-tank, and the shot hit him so precisely on the head as to kill him at once; had it struck any less vital part he would probably have dived into the water and disappeared; when seized, the iguana has the power of hitting so sharp a blow with its scaly tail as to cause a severe wound and even sometimes a broken limb."

We regret that want of space forbids us to quote entire Prof. Haeckel's account of a Buddhist temple built on the wooded heights above Kaduwella, and the scene of constant pilgrimages. It was constructed originally out of a natural grotto, the back part of the temple being composed of the bare rock, from which also is hewn the colossal figure of Buddha, which is invariable in all Buddhist temples. Almost as invariable is the adjoining Dagoba, a bell-shaped dome without any opening, containing a relic of Gotama. The size of the dagobas varies from that of a large church bell to the circumference of the dome of St. Peter's at Rome. Near the Dagoba is generally to be seen a large Bo-Ga, or sacred fig-tree (*Ficus religiosa*).

"These 'Buddha-trees' with their venerable stems, fantastic roots, and colossal crown of foliage form a prominent feature in the picturesque surroundings of the temples; their leaves, which are heart-shaped, with long stalks, quiver like our aspens."

The description given by Prof. Haeckel of the Royal Botanic Garden at Peradenia will be read with interest by all who value the efforts, whether of governments or of individuals, to encourage scientific knowledge by placing the means of gaining it within the reach of all. This admirable institution was founded sixty years ago on the site of an ancient royal residence, and placed under the direction of Dr. Gardner. His successor, Dr. Thwaites, the learned compiler of the first "Flora Ceylanica," laboured for thirty years to render the garden worthy of its extraordinary advantages of position and climate. On his retirement a few years ago, Dr. Henry Trimen was appointed director, and from him Prof. Haeckel received a pressing invitation, which all that he had heard and read of Peradenia urged him to accept.

Peradenia is now connected with Kandy, the original capital of Ceylon, by a railway, the first in the island. Prof. Haeckel notes by the way that railway travelling affords the greatest delight to the natives, many of whom make the journey up and down daily for the mere pleasure of the ride! It is the only indulgence on which they are willing to spend their money, and fortunately the line is a cheap one. The journey is of between four and five hours' duration, and the first half of it lies through low lands covered with swampy jungle, alternating with rice fields and swamp meadows. After that, the line begins to ascend, and a constant succession of beautiful mountain landscapes unfold themselves to the view. One of the most magnificent of these is afforded to the traveller at the point called the "Sensation Rock." "Here the line, after passing through several tunnels, runs under projecting cliffs at the edge of a precipice with a sheer descent of 1200 to 1400 feet. Roaring waterfalls from the rocky heights on the left are spanned by railway bridges, and, dashing downwards, are dissolved into spray before they reach the foot of the precipice; the sunshine striking them forms them into glittering rainbows. The green valley lying far below our feet is covered partly with jungle, partly with cultivated land scattered over with huts, gardens, and rice-fields, arranged in terraces. Towering above all other trees, rise the giant stems of the majestic Talipat palm, queen of all the palms of Ceylon (*Corypha umbraculifera*). Its perfectly straight white stem resembles a slender marble pillar, and often exceeds 100 feet in height. Each of the fan-shaped leaves which form its stately crown covers a half-circle sixteen feet in diameter; they, like every other part of the tree, are turned to manifold uses, being especially employed for thatching; they formerly provided the Singhalese with a substitute for paper, and are still used in that capacity. The old Puskola manuscripts of the Buddhist monasteries are all written with an iron style upon this "ola" paper, narrow strips of talipat leaves boiled and dried in the sun. The stately talipat palm blooms but once, usually between the fiftieth and eightieth year of its life; the pyramidal clusters of flowers crowning the summit of the palm, reach the length of thirty to forty feet, and are formed of millions of small yellow-white blossoms; when the seed-vessels ripen, the tree dies. By a fortunate chance it happened that an unusual number of talipat palms were in flower during my stay; I counted more than sixty between Rambukhana and Kadugannawa, and more than a hundred during the whole railway journey. Excursions were made from Colombo to witness the rare and beautiful sight."

The following extract gives Prof. Haeckel's first impression of the Botanic Garden of Peradenia:—

"The entrance to the Garden is through a noble avenue of india-rubber trees (*Ficus elastica*). The milky sap of this tree thickens into *caoutchouc*. Young plants of it are cultivated in heated rooms of our cold north, for the sake of the decorative beauty of their oval sap-green leaves; but while with us india-rubber plants of six or eight feet high, are esteemed a wonder, here in their native land they take rank with the noblest of forest trees, and would rival our oaks in size and strength. A huge crown of many thousand leaves proceeding from horizontal branches 40 to 50 feet long, covers the superficial area of a stately palace, and from the base of its powerful stem rises a network of roots, often between 100 feet and 200 feet in diameter, more than the height of the tree itself. This marvellous mass of roots rises on all sides and twists round the tree in such a manner, that the natives have given it the name of the "snake-tree." [1]

"Scarcely had I recovered from my astonishment at this

[1] "Like snakes in wild festoon
In famous wrestlings interlaced
A forest Laocoon."
(Hood's Poem of "The Elm Tree.")

wonderful avenue of snake trees, when my attention was arrested by a noble group of palms, including nearly all those indigenous to the island, and a number of foreign representatives of this noblest of tropical trees; all festooned with masses of flowering creepers, and adorned with graceful ferns growing at their base. Another similar, but larger and more beautiful group of palms stands at the further end of the avenue. Here the path divides and leads on the left to a little eminence, on which the director's bungalow stands. This charming residence is, like most of the villas of Ceylon, a low one-storied building, surrounded by a verandah, the projecting roof of which is supported by a row of white pillars." . . . The villa stands on the highest point of the garden, which covers an area of 150 acres, and overlooks the noble Mahawelli River, which encircles it on three sides. Its position and climate are unusually favourable for the cultivation of all the wonders of the Ceylon flora.

"In four days spent in Peradenia," says Prof. Haeckel, "I learnt more of the life and nature of the vegetable world than I should have acquired by as many months of close botanical study at home. I can never be grateful enough to my good friend Dr. Trimen for his hospitality and the rich stores of learning which he placed at my service; the days spent in his bungalow were among the most fruitful of my life.

"Another English botanist, Dr. Marshall Ward, was at Peradenia at the same time as myself; he had pursued his studies for the most part in Germany, and bore the official title of 'Royal Cryptogamist.' He had been sent here two years previously by the English government to study the coffee-leaf disease which for many years has raged with inceasing violence in the coffee-plantations of Ceylon, and has in great measure destroyed this valuable source of revenue to the island. Dr. Ward made many valuable observations and experiments on the natural history of the microscopic fungus, which contains the germ of the disease; but unfortunately he did not succeed in discovering any radical remedy for it. Instead, therefore, of receiving the gratitude due to him for his assiduous labours, he found himself violently taken to task by the press, and especially by the coffee planters. As if the hundreds of European naturalists engaged at the present time in investigating the nature and causes of similar plant epidemics should all be expected to discover a remedy for the disease they are studying! That this is seldom successfully done is a well established fact, and no axiom is more devoid of truth than that current in what are called 'cultivated circles,' that 'every disease has its cure.'

"It would lead me too far, and would weary my readers to no purpose were I to attempt a mere verbal description of the botanical paradise of Peradenia; even the drawings and water-colour sketches which I there made give a very inadequate idea of its beauties. Unlike most of our botanic gardens in Europe, the plants are not disposed in stiffly laid out beds, but are arranged with a regard to æsthetic effect, as well as to scientific classification. The principal groups of trees and the plants of kindred families are gracefully divided by smooth lawns of turf, and good paths lead from one to the other. In a more retired part of the park are the less attractive and more useful growths of both hemispheres, the seeds, fruit, and shoots of which are distributed among the gardeners and growers of the island. In this way the garden has been for many years of great practical utility as a centre of experiments and a garden of acclimatisation."

We must conclude our extracts with a suggestion from Prof. Haeckel which seems worthy of notice. He says:

"The singularly favourable climatic and topographical conditions of the Garden of Peradenia would seem to fit it for a wider sphere of scientific usefulness as a botanic station. In the same way that zoological students are now provided with invaluable means of assistance in the prosecution of their studies by the establishment of zoological stations on the sea-coast (at Naples, Roscoff, Brighton, Trieste, &c.) might young botanists in such a botanic station as Peradenia learn and accomplish as much in one year as they would in ten years under less favourable circumstances. Hitherto the tropical zone, the richest of all in materials for study, contains no such institution. If the English Government would establish and maintain a botanic station at Peradenia and a zoological station at Galle, she would add an important item to the services bestowed on science by her *Challenger* Expedition and other similar scientific undertakings; and she would once more put to shame those States of Continental Europe who can find no more useful or beneficial way of spending their money than in the manufacture of breech-loaders and cannon."

KŒNIG'S EXPERIMENTS IN ACOUSTICS [1]

II.

IN a preceding article it was recounted how Kœnig has applied the principle of the wave-siren to prove by direct experiment the influence which *phase* has upon the quality of a sound. The view taken by Kœnig that this difference may be completely explained by observing the difference in the form of the resultant waves was also briefly set forth. Two large diagrams were given which illustrated the matter very completely. A set of odd members only was taken from a harmonic series in which the amplitudes decreased in inverse ratio to the order of the harmonic; the series having for the ratios of its frequencies the numbers $1 : 3 : 5 : 7 : 9$, with the respective amplitudes $1 : \frac{1}{3} : \frac{1}{5} : \frac{1}{7} : \frac{1}{9}$. These were compounded together, firstly without any difference of phase, and secondly with a difference of phase of $\frac{1}{4}$ the wave-length. The resultant in one case showed well-rounded sinuosities, and in the other angular zigzags. In the first case the whole of the components had at their origin zero amplitudes, in the second they all, at the origin, had their individual amplitudes at maximum values. Kœnig found the result, when the curves were actually tried upon his wave-siren, to be that though the constituent tones in the two cases were identical in pitch and amplitude the resultant sound from the zig-zag curve was harsh and strident compared with that produced by the rounded sinuosities; thus clearly proving an influence due to difference of phase only.

We give in Fig. 4 the resultant curves found by Kœnig in four typical instances. The first line of curves (a) shows the resultants of a set of ten partial tones with regularly diminishing amplitudes, as compounded together, first with *no* difference of phase, then with differences of $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ respectively. The sounds corresponding to these combinations were found to be loudest and most forcible for difference of phase $= \frac{1}{4}$, and to be least forcible for $d = \frac{3}{4}$, the phases of 0 and $\frac{1}{2}$ having intermediate intensity.

Fig. 4 (b) illustrates the combination first mentioned above, for which the differences of phase $\frac{1}{4}$ and $\frac{3}{4}$ produced a strident tone as compared with 0 and $\frac{1}{2}$, which agreed in giving a smoother resultant sound.

In Fig. 4 (c), which represents a series of harmonic tones with amplitudes whose successive values diminish each time by $\frac{1}{2}$, the results agreed in general with those obtained from the same series when the amplitudes diminished less suddenly, the phases $\frac{1}{4}$ and $\frac{3}{4}$ corresponding respectively to the maximum and minimum of intensity.

In Fig. 4 (d), where again we deal with a series of odd harmonics only, there is a harsher and louder sound for $d = \frac{1}{4}$ and $d = \frac{3}{4}$ than for $d = 0$ and $d = \frac{1}{2}$.

In order to carry out these researches more fully, Kœnig has constructed a very large and complete appa-

[1] Continued from p. 206.

ratus on the principle of the wave-siren. Its mode of operation will be best understood by reference to Fig. 5, taken by Dr. Kœnig's permission from his work, "Quelques Expériences d'Acoustique." Upon a strong stage about 4 feet high is mounted a series of 16 brass disks, cut at their edges into sinusoidal wave-forms, all fixed upon a common axis, and capable of being rotated by a band and treadle. The wave-forms cut against the contours of these 16 disks represent a harmonic series of 16 members of decreasing amplitude, there being just 16 times as many sinuosities on the largest as on the smallest disk. Against the edge of each of these wave-disks wind can be blown by a special mouth-piece in the form of a horizontally-placed slit connected by a tube to a powerful wind-chest mounted upon the stand of the instrument. We have, in fact, here sixteen simple wave-sirens of different pitch all combined together in such a manner that any one of them can be used separately. When the axis is rotated the wave-disks pass in front of the slits through which the wind is blown, and throw the issuing streams of air into vibration. Each wave-disk thus sets up a perfectly simple tone. We have therefore provided in this instrument a fundamental sound with its fifteen upper partial tones. It is clear that any desired combination can be made by opening the appropriate stops on the wind chest. In order to vary at will the *phase* in which these elementary tones are combined, a very ingenious arrangement is adopted. The brass tubes which terminate in the fifteen mouth-pieces are connected by flexible caoutchouc pipes to the wind-chest. The mouth-piece tubes are mounted upon a plate in such a way that they can slide up and down in curved slots concentric with the disks. By the aid of templates cut out in comb-fashion, and screwed to a lever handle, the mouth-pieces, or any set of them, can be displaced at will; thereby introducing any required difference of phase. Fig. 6 shows the way in which the fifteen mouth-piece slits are arranged with respect to the wave-disks; there being two series along two different radii, eight corresponding to the even members of the series, and seven to the odd members. They are set with the slits each opposite a summit or crest of its wave-disk, so that all the slots are closed simultaneously. This in Kœnig's nomenclature corresponds to a phase of $\frac{3}{4}$; the minimum condensations of all the individual air-waves occurring simultaneously.

Suppose now it is desired to change the phase in which the waves are compounded, and to make all the maximnm condensations occur simultaneously (*i.e.* $d = \frac{1}{4}$): all that

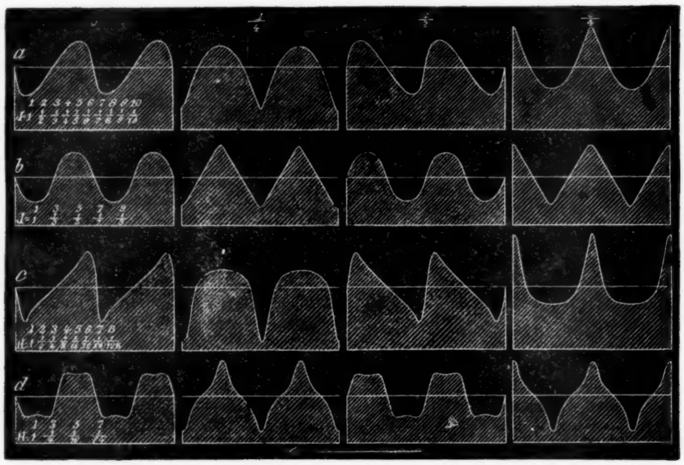

FIG. 4.—Curves resulting from the superposition of harmonic series in various pha-es.

is necessary is to move the mouth-pieces of the odd series forward to the positions shown in Fig. 7, where all the slits are seen to be opposite hollows of the wave-disks. This is, of course, done by pushing up under the lower series of tubes a comb-like template which moves each through half its own wave-length.

The template that is used for causing the difference of phase to become zero, is shown in Fig. 8, attached to the lever-handle. Here the first, or fundamental slit, being always immovable, the fourth, eighth, and twelfth slits will not require to be moved, but the intermediate members will require shifting by $\frac{1}{4}$, $\frac{1}{2}$, or $\frac{3}{4}$ of their wave-length, according to their place in the series. When this set of positions is attained, the condensation is increasing simultaneously in all the sixteen waves, and reaches its mean value in all at the same moment.

The fourth method of placing the slits, so as to produce difference of phase $= \frac{1}{2}$ in the combination, is shown in Fig. 9.

Having thus described the peculiar arrangements for experimenting, we will briefly give Kœnig's principal results.

If first we take simply the fundamental and its octave together, the total resultant sound has the greatest intensity for $d = \frac{1}{4}$, and at the same time the whole character of the sound becomes somewhat more grave, as if the fundamental tone predominated more. The intensity is least when $d = \frac{3}{4}$. If, however, attention is concentrated on the octave-note while the phase is changed, the intensity of it appears to be about the same for $d = \frac{1}{4}$ and $d = \frac{3}{4}$, but weaker in all other positions.

The compound tones formed only of odd numbers of the harmonic series have always more power and brilliancy in tone for phase-differences of $\frac{1}{4}$ and $\frac{3}{4}$, than for o and $\frac{1}{2}$, but the quality for $\frac{1}{4}$ is always the same as that for $\frac{3}{4}$, and the quality for o is always the same as for $\frac{1}{2}$. This peculiary corresponds precisely to the peculiarity of the curves (see Fig. 4, *b* and *d*), in which the resultant wave-forms are correspondingly identical.

For compound tones corresponding to the whole series, odd and even, there is, in every case, minimum intensity, brilliancy, and stridence with $d = \frac{3}{4}$, and maximum when $d = \frac{1}{4}$; the phases o and $\frac{1}{2}$ being intermediate. A reference to Fig. 4, *a* and *b*, will here show that the maxima of

intensity occur in those wave-forms which yield a sudden and brief maximum condensation. It is clear, also, that as the phase 0 and the phase $\frac{1}{2}$ are not identical, the action on the ear is not the same when a sudden condensation is produced and dies away gradually, as when a condensation gradually rises to its maximum and then suddenly falls off. It may be added, that no explanation of this very novel result has yet been advanced from a theoretical point of view.

There only remains one small detail of interest to narrate. Observing that wave-forms in which the waves are obliquely asymmetrical—steeper on one side than on the other—are produced as the resultant of a whole series of compounded partial tones, it occurred to Kœnig to produce from a perfect and symmetrical sinusoidal wave-curve a complex sound, by the very simple device of turning the slit, through which the wind was blown against it, into an oblique position.

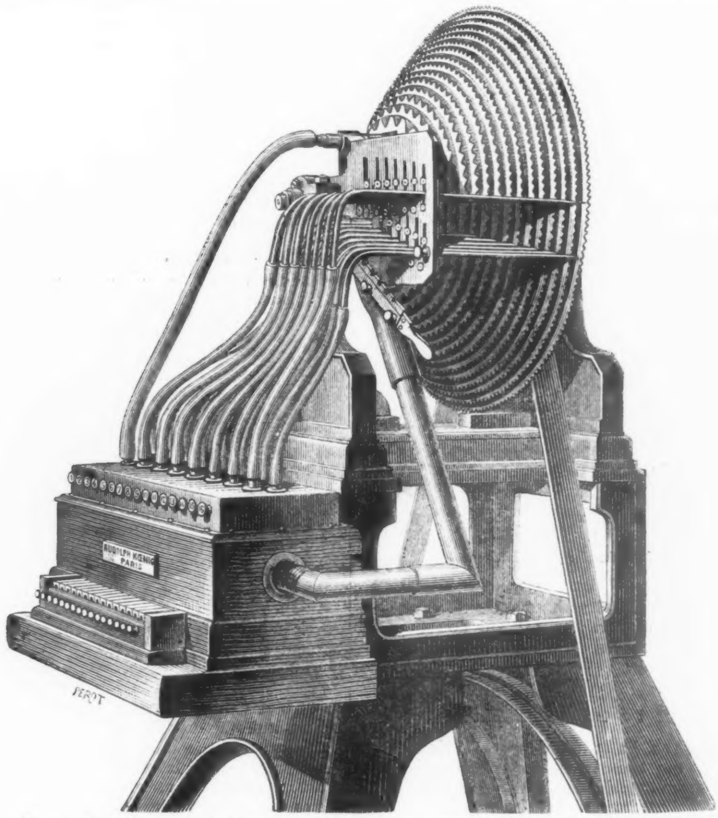

FIG. 5.—Kœnig's Wave-disk Apparatus for synthetic researches on the quality of compound tones.

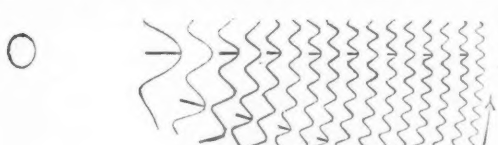

FIG. 6.—Positions of the slits in front of the wave-disks for combining the sounds with phase-difference $\frac{3}{4}$.

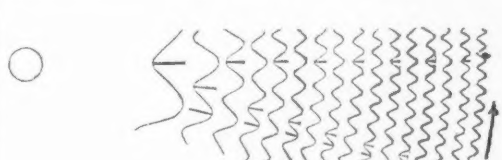

FIG. 7.—Position of the slits for phase-difference $\frac{1}{4}$.

In Fig. 10 is drawn a simple symmetrical wave-form *eglnprtv*. If a series of these are passed in front of a vertical slit, such as *a b*, a perfectly simple tone, devoid of upper partials, is heard. But by inclining the slit, as at *a b'*, the same effect is produced as if the wave-form had been changed to the oblique outline *e' g' l' n' p' r' t' v'*, the slit remaining upright all the while. But this oblique form is precisely like that obtained as the resultant of a decreasing series of partial tones (see Fig. 4, *a*). If the slit is inclined in the same direction as the forward movement of rotation of the wave-disk, the quality produced is the same as if all the partial tones coincided at their

origin, or with phase difference = o. If the slit be inclined in the opposite direction the quality is that corresponding to phase-difference = $\frac{1}{2}$. It is easy then to examine whether or not the effect of these differences of

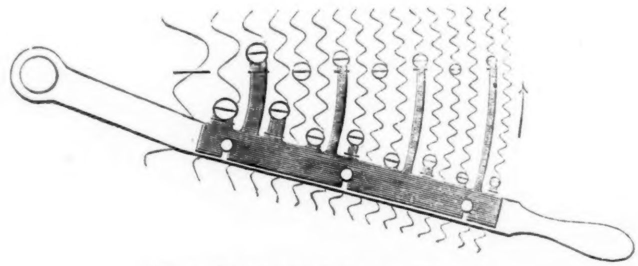

FIG. 8.—Position of the slits for phase-difference o.

phase on the ear is the same, by merely inclining the slit forward or backward. Kœnig finds invariably a purer and more perfect sound with phase-difference = o, and a

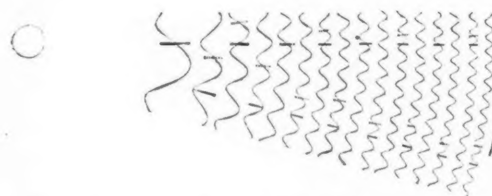

FIG. 9.—Position of the slits for phase-difference $\frac{1}{2}$.

more strident and nasal sound with phase-difference = $\frac{1}{2}$. This result is so easy to verify that it will doubtless be tried by many experimenters. Indeed many of the researches with the wave-disks are so easily repeated without any special or expensive apparatus that they will

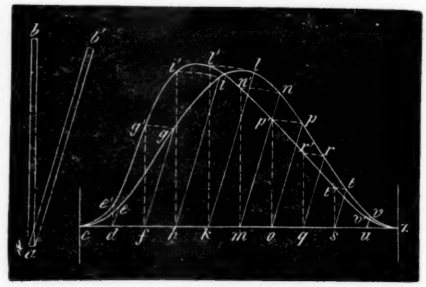

FIG. 10.—Effect of inclining the slit.

surely win a place amongst the familiar experiments of acoustics. S. P. T.

HONOUR TO M. PASTEUR

AT the *séance* of the Paris Academy of Sciences on the 26th ult., the President (M. Jamin) stated that a gathering of *savants*, friends, and admirers of M. Pasteur having resolved to present him with a medal commemorative of his remarkable discoveries, a committee had been appointed to watch the execution of it. On completion of the work, this committee, on June 25, repaired to M. Pasteur's house to present the medal, which is the design of M. Alphée Dubois, and happily recalls the physiognomy of its distinguished recipient. The meeting included MM. Dumas, Boussingault, Bouley, Jamin, Bertin, Tisserand, Davaine, and others. On this occasion M. Dumas delivered an address, in which he recalled the labours of M. Pasteur; and after receiving the medal, M. Pasteur made a few observations in reply. The two speeches have been, on the suggestion of M. Thenard, inserted in *Comptes rendus*, and we here reproduce them, in translation. M. Dumas said:—

"MY DEAR PASTEUR,—Forty years ago you entered this house as a student. From the first your teachers foresaw that you would be an honour to them; but none would have ventured to predict what brilliant services you were destined to render to science, to the country, and to the world.

"Your earliest labours banished occult forces for ever from the domain of chemistry, by explaining the anomalies of tartaric acid.

"Confirming the vital doctrine of alcoholic fermentation, you extended this doctrine of French chemistry to the most diverse fermentations, and you gave to the manufacture of vinegar, rules which industry now applies with thankfulness.

"Among these infinitely minute living things you discovered a third kingdom, to which those beings belong which, with all the prerogatives of animal life, do not need air to live, and which find the heat they require in the chemical decompositions they excite around themselves.

"The profound study of ferments gave you the complete explanation of alterations undergone by organic substances—wine, beer, fruits, animal matters of all kinds: you explained the preservative *rôle* of heat applied to their conservation, and you learned to regulate the effects of it according to the temperature necessary to cause the death of ferments. Ferments when dead produce ferments no more.

"It was thus that you were led to maintain throughout the extent of the organic kingdoms the fundamental principle according to which life is derived from life, and which rejects as a useless and unfounded supposition the doctrine of spontaneous generation.

"It is thus that, showing air to be the vehicle of the germs of most ferments, you learned to preserve without alteration the most putrescible matters, by keeping them from all contact with impure air.

"Applying this idea to the alterations, so often fatal, to which wounds and sores are liable when the patients inhabit a contaminated place, you learned to guard them from this danger by surrounding their limbs with filtered air, and your precepts, adopted by surgical practice, daily insure to it successes it knew not before, and give its operations a boldness of which our predecessors had no presentiment.

"Vaccination was a beneficent practice. You have discovered its theory and enlarged its applications. You have learned how to produce vaccine matter from a virus; how a fatal poison becomes a harmless preservative. Your researches on anthracoid disease, and the practical consequences from them, have rendered to agriculture a service of which all Europe feels the value. But the results already obtained, however brilliant, are nothing in comparison with the applications which may be anticipated from the doctrine to which they are due. You have furnished a sure basis to the doctrine of viruses by associating it with the theory of ferments; you have opened a new era for medicine by proving that every virus may have its vaccine-matter.

"Amid these admirable conquests of pure science, natural philosophy, and practice, we might forget that there is one part of the country where your name is pronounced with particular respect—the country once so fortunate, where the silkworm is cultivated. A malady which had spread terror among all the families of our southern mountains had destroyed the fine races they had produced with much care and wise selection. The ruin was complete. *Now*, thanks to your processes of scientific *grainage*, the cultivators have regained their security, and the country sees one of its sources of wealth reviving.

"My dear Pasteur, your life has only known successes. The scientific method, of which you make such certain use, owes you its finest triumphs. The Normal School is proud to count you among the number of its students; the Academy of Sciences is elated at your researches; France ranks you among her glories.

"At a time when, from all parts, testimonies of the public gratitude are arising towards you, the homage we come to offer you in name of your admirers and your friends, may seem to you worthy of special attention. It emanates from a spontaneous and universal sentiment, and it preserves for posterity the faithful image of your features.

"May you, my dear Pasteur, long enjoy your honour, and contemplate the fruits, ever richer and more numerous, of your labours. Science, agriculture, industry, humanity, will feel eternal gratitude to you, and your name will live in their annals among the most illustrious and the most venerated."

M. Pasteur replied as follows:—

"MY DEAR TEACHER,—It is forty years, indeed, since I had the good fortune to make your acquaintance, and since you taught me to love science and honour.

"I came from the provinces; after each of your lectures, I went out from the Sorbonne, transported, and often moved even to tears. From that time, your talent as professor, your immortal works, your noble character, have inspired me with an admiration which has only increased with the maturity of my mind.

"You must have divined my sentiments, my dear Teacher. There is not a single important circumstance of my life or of that of my family, circumstance happy or painful, which has found you absent, and which you have not, in some sort, blessed.

"And here you are still among the foremost in expression of these testimonies, excessive truly in my opinion, of the esteem of my teachers, who have become my friends.

"And what you have done for me you have done for all your students. It is one of the distinctive traits of your nature. Behind individuals you have always contemplated France and her greatness.

"What shall I do henceforth? Hitherto great eulogia had inflamed my ardour, and only inspired the idea of rendering myself worthy of them by new efforts; but those which you have addressed to me, in name of the Academy and of learned societies, truly overpower me."

NOTES

THE Council of the Society of Arts have elected C. W. Siemens, D.C.L., LL.D., F.R.S., as Chairman for the ensuing year.

IT has now been definitely decided to build a permanent observatory on Ben Nevis.

IT is announced that the Duke of Bedford has given 5000*l.* for the endowment of a lectureship in physical science at Balliol College, Oxford.

DR. GEORGE DICKIE, ex-Professor of Botany in the University of Aberdeen, died at Aberdeen on Saturday morning. The deceased, who was a native of Aberdeen, and was educated at Marischal College, was for some time in practice in the city as a doctor and dispensing chemist. His tastes, however, lay very markedly in the line of botanical research. He held the Botanical Chair in the Queen's College, Belfast, for a number of years, and on the fusion of King's College and Marischal College into one Aberdeen University he was appointed Professor of Botany. He discharged the duties for seventeen years, only resigning in 1877 on account of impaired health. Dr. Dickie had written numerous papers, and published some books connected with his favourite study, these including "A Handbook of Flora of Aberdeenshire," which was subsequently supplemented by a much larger volume, "The Botanist's Guide," published in 1860. His favourite department of botanical study was *Algæ*. On the return of the *Challenger* expedition he was, for the purposes of study, supplied with the *Algæ* collected during the cruise.

LET us draw the attention of local natural history societies to the prospectus of the forthcoming International Fisheries Exhibition. On some points these societies might be able to render material aid to the Commissioners, who, we believe, are desirous of enlisting their co-operation. Indeed, all of our readers interested in such an exhibition should procure copies of the prospectus by applying to the Secretary, 24, Haymarket, London, S.W. The Exhibition will cover a very wide field, and therefore appeals to a great variety of interests.

PROF. A. SMITH of the Swedish National Museum, who has been delegated as the representative of Sweden at the Fishery Exhibition in London next year, has commissioned Dr. A. Malm to prepare a collection of the sea fish species of the west coast of Sweden, to be forwarded at the expense of the museum. Dr. Malm will also arrange the collection which the Gothenburg Museum will exhibit, Mr. O. Dickson having offered to defray the expenses thereof. Mr. Dickson has been chosen as the "honorary correspondent" of Sweden at the exhibition.

THE *Sydney Morning Herald* justly animadverts in strong terms on the geography in some of the school books in common use in New South Wales, under the sanction of the government. These are published by a well-known Glasgow firm, and no attempt has been made to adapt them either to the conditions of the Southern Hemisphere, or to recent knowledge. The *Herald* gives some choice examples of the "facts" taught to the rising generation at the Antipodes. "At twelve o'clock," the book tells us, "in the day, when you go out to play, if you look at the part of the sky where the sun is shining, that part is called the south; then turn and look behind you, where the sun never comes, that is the north, it is opposite the south." Again, "the country you live in is Ireland; it is called an island because it has water all round it, and is not joined to any other country;" the *Herald* states, "and this has been taught to Australian children, at the expense of the public of New South Wales, for the last thirty or forty years." In a chapter headed "Australasia," there is the following passage:—"The name of Austral-

asia or Southern Asia is given to a number of islands in the Indian and Southern Oceans. The largest of these is New Holland, which is nearly as extensive as the whole of Europe. Much of the greater part of New Holland is unknown to Europeans; but there are British settlements on the coast. It is inhabited by a race of savages who are among the lowest and most degraded that are to be found in the world." The moral seems to us to be that the Australians ought to compile their own school-books.

THE invertebrate portion of the collection of fossils made by the late Mr. Charles Moore, now in the Royal Literary and Scientific Institution of that city, is being classified and arranged by Messrs. R. Etheridge, jun., and R. Bullen Newton, of the British Museum. The vertebrates will afterwards be examined by Mr. Wm. Davies of the British Museum.

OUR contemporary, *L'Electricité*, in an able article on the progress of electrical science, remarks that in all the most striking of recent advances it is improvement rather than invention that comes to the front, and that no compromise or equivocation can deny justice to the real original discoverers. "Bell does not efface Reis in spite of the recent Chancery suit; Faure cannot destroy Planté; and Swan, Edison, and the others cannot suppress the anterior labours of Changy."

IT is proposed to establish a "German Botanical Society" for the whole of the "Vaterland," founded on, and an extension of, the already existing "Botanical Society for the Province of Brandenburg." A conference for the purpose of founding the new society is summoned to meet at Eisenach on September 16; the conveners including many of the most distinguished botanists from all parts of Germany.

THE most recent issue of the "Bulletin de la Fédération des Sociétés d'Horticulture de Belgique," published under the authority of the Belgian Minister of the Interior, contains the usual evidence of the activity of horticulture in that little kingdom, as well as the ninth annual issue of Prof. Morren's valuable "Correspondance Botanique."

AT the sixth anniversary meeting of the Sanitary Institute, Mr. E. C. Robins read a paper on the work of the Institute. After dealing with the objects of the institution, which are to awaken the conscience of the country generally to the importance of preventive measures in arresting the spread of disease, to acquire and impart information upon all matters connected with the public health, and to influence the laws which might be framed for the public good in connection with sanitary matters, the reader addressed himself to these things, which still remained to be performed. With respect to the examination conducted by the Institute, it might soon be necessary to consider the extent to which technical education should be required as a condition precedent to such examination if the standard of efficiency for the offices of local surveyors or inspector of public nuisance was to be permanently raised. He was happy to think that during the last six years science classes were being established throughout the country by the municipal authorities of various cities. Instances were then given by Mr. Robins of the disabilities under which sanitarians laboured. The influence of the institute might be also used in favour of the public, and especially of the humbler portion of it, by getting a revision of the Water Companies' Act, which had granted to them inquisitorial powers quite inconsistent with public purposes of a sanitary nature. Another and pressing want of the day was greater uniformity in the bye-laws governing the action of local authorities.

A MEMORIAL has been presented by the Council of the Society of Arts to the Secretary of State for India calling attention to the great and growing demand for the services of persons skilled in forest cultivation and analogous occupations, in India and the Colonies generally, and to the increasing desire on the part of land agents, land stewards, and bailiffs to acquaint themselves with the scientific and technical treatment of plantations, woods, and forests, as a means of fitting them for the more satisfactory management of landed estates in the United Kingdom. The memorialists believe that no suitable provision exists at any of our great centres of instruction in this country for the teaching of natural science in its special reference to forestry, nor for the scientific teaching of sylviculture in any of its branches; and are of opinion by grafting itinerating classes for observation of the practical method adopted in the regularly worked forests abroad on classes for scientific teaching at home, established in connection with such a school as already exists at Cooper's Hill, satisfactory means could be afforded of enabling students to obtain the requisite knowledge, both theoretical and practical, to qualify them for entering upon the duties appertaining to forest management, whether in India, our colonies, or elsewhere. They therefore express their earnest hope that steps may be taken by the Council to establish a department for the teaching of forestry in the Royal Engineering College at Cooper's Hill.

WE have received a "Catechism" of modern elementary chemistry, or solutions of questions set at examinations of the London University, for the last twenty years, by the Lecturer on Chemistry at Downside. The appearance of a book like this is a further indication of what we are drifting to in this country in regard to science teaching. The numerous examinations have created a method of study which will meet the examination with the least expenditure of labour on the part of the student. Numerous small books on different branches of science have appeared with this object, containing a mass of facts simply crammed into them, and hence have earned the very appropriate term "cram books." They serve to "get up the Exam.," and are of no further use, generally creating a dislike of the subject. The little book before us is scarcely one of these, but it is an examination helper more in the manner than the substance. It contains over 400 questions that have been actually set, with answers appended, and will undoubtedly be useful in preparing for the matriculation and other examinations. It is intended to be used as an aid to a text-book, and as such is to be commended.

M. DELAPORTE, who has been exploring the celebrated remains of Cambodia on behalf of the French Government, propounds the idea—novel, we believe—that the remains at Angkor and elsewhere are due neither to Buddhism nor Serpent-worship, but were born of Brahminism. He finds figures and emblems of Siva, Vishnu, Rama, and other Brahminic gods and heroes everywhere. M. Delaporte has brought home numerous photographs, mouldings, &c., and the details of his discoveries, on which his new theory is based, will be anxiously looked for by archæologists. A brief note on the subject will be found in the *Bulletin* of the Society for Encouraging National Industry (May).

CONSIDERABLE consternation has been caused by the appearance of the Phylloxera at several points in the Canton of Neuchatel and Geneva.

IN order to secure the greater purity in the atmosphere of the St. Gothard Tunnel, an attempt is to be made to propel the locomotives by electricity. Experiments, for which the sum of 180,000 francs is set apart, are now being made at Berne with this object.

AN earthquake shock lasting four seconds was felt on Monday morning at half-past four o'clock at Laibach and Trieste. Another shock, lasting longer, was felt at nine o'clock. A smart earthquake shock, accompanied by subterranean thunder, was

felt at Ardon, Canton Valais, on Tuesday, last week. A slight shock was felt at Geneva on Monday.

THE seven aëronautical ascents arranged for July 14 were made at Paris at 4 o'clock as contemplated. But it was impossible to make any of the scientific experiments which had been prepared, owing to the violence of the wind. One of the balloons exploded at 2000 feet, and the aëronauts were precipitated to the ground with terrific velocity, happily without any loss of life or injury of consequence. They were saved by a miracle, their car having been suspended in a gap between two houses. The catastrophe was produced by their imprudence, having placed their canvass in a net which was not quite large enough. The inferior part of the canvass being left unprotected exploded when it was filled by the expansion of the gas. This is a warning to aëronauts to place the right balloon in the right netting.

THE *Journal Officiel* publishes a table giving the exact number of public teachers in France; there are 32,463 females and 49,201 males. The salary of the largest number of them varies from 24*l*. to 100*l*., only 198 females and 673 males having a salary of 100*l*. and upwards a year. Most of them receive pay of about 1*l*. per week. Under the present system their salaries involve an expense of little less than 3,000,000 sterling, and the Minister of Public Instruction refuses to propose any further increase under this head.

THE Belgian Academy offers a prize of 3000 francs for the best study of the subject of destruction of fishes by pollution of rivers. Four topics are specified—(1) What are the matters special to the principal industries, which, mixing with the water of small rivers, render them incompatible with the existence of fishes, and unfit for public supply, and for use by cattle? (2) A list of the rivers of Belgium, which are now "depopulated" by this state of things, with indication of the industries special to each of these rivers, and list of the edible fish that lived in them prior to the existence of those works. (3) Investigation and indication of practical means of purifying the waters at issue from the works, to render them compatible with the life of fishes without compromising the industry, combining the resources which may be offered by construction of basins of decantation, filtering, and the use of chemical agents. (4) Separate experiments on the matters which in each special industry cause the death of fishes, and on the degree of resistance of each edible fish to destruction. Memoirs are to be sent in before October 1, 1884.

AN illustrated treatise on Coal-tar Distillation, by Prof. Lunge of Zurich, and an essay on the Noctuidæ of North America, by Mr. Grote, with coloured illustrations, will be the next contributions, respectively to technical science and natural history, issued by Mr. Van Voorst.

THE additions to the Zoological Society's Gardens during the past week include a Tricoloured Lory (*Lorius tricolor*) from the Malay Archipelago, presented by Mr. H. Harraden; a Common Marmoset (*Hapale jacchus*) from Brazil, presented by Mr. G. W. Drabble; sixty-one Restless Cavies (*Cavia caprera*), British, presented by H.R.H. the Prince of Wales, K.G.; a Puff Adder (*Vipera arietans*) from South Africa, presented by Capt. Owen; a Heloderme Lizard (*Heloderma horridum*) from Mexico, presented by Sir John Lubbock, Bart., F.Z.S.; a Littoral Callichthys Fish (*Callichthys littoralis*) from Demerara, presented by Mr. George Little; a Bonnet Monkey (*Macacus radiatus*), a Macaque Monkey (*Macacus cynomolgus*) from India, a Levaillant's Cynictis (*Cynictis penicillata*) from West Africa, a Great Eagle Owl (*Bubo maximus*), European, deposited; a Black-fronted Teetee (*Callithrix nigrifrons*) from Brazil, a Black-faced Ibis (*Theristicus caudatus*) from South America, a Cedar Bird (*Ampelis cedrorum*), six Yellow-headed Troupials (*Xanthrocephalus icterocephalus*) from North America, a Kolb's Vulture (*Gyps kolbii*), a Sociable Vulture (*Vultur auricularis*) from Africa, two Ceylonese Hanging Parrakeets (*Loriculus asiaticus*) from Ceylon, an Annulated Snake (*Leptodira annulata*) from Panama, purchased; a Turquosine Grass Parrakeet (*Euphema pulchella*), a Geoffroy's Dove (*Peristera geoffroii*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN

DAYLIGHT OBSERVATIONS OF WELLS' COMET.—At the Dudley Observatory, Albany, this comet was observed on the meridian as early as June 5, just before noon, and again on June 11 and 12. The aperture of the object-glass of the transit-circle is 8 inches, the focal length of the telescope 10 feet. A detailed description, with engraving of the instrument with which these notable observations were made, will be found in vol. i. of the *Annals* of the Dudley Observatory. On June 5 the comet was not perceived until forty seconds after transit, and was observed with difficulty on a single wire, but the positions obtained on the subsequent dates were considered very satisfactory. The true nucleus was seen at the observation of June 11, made about sixteen hours after the perihelion passage, and the estimated diameter of the disc was 0″·75. The nebulosity of the coma was uniform and faint about 10″ in diameter. It is stated that "while the nucleus was observed for position, the coma was scarcely noticed at all." The atmospheric conditions on this day were such as are well known to conduce to easy vision of objects in daylight. "The sky was sparsely covered with cumulus clouds, while the intermediate clear spaces were exceedingly transparent." On June 12 the nebulosity had increased in brightness, but the image was very unsteady, and "either for that reason, or because of the increased brightness of the nebulous screen, the nucleus proper could not be seen." The very favourable observation on the preceding day gave the following apparent position of the comet:—

	M.T. at Albany.		R.A.		Decl.
	h. m. s.		h. m. s.		° ′ ″
June 11, at	0 1 21·4	...	5 21 3·91	...	+19 9 17·6

This place agrees closely with that deduced from a parabolic orbit calculated by Mr. Wells, which will not be materially improved, without a discussion of the entire series of observations. The elements of this orbit are:—

Perihelion passage, June 10·53006 Greenwich M.T.

	° ′ ″	
Longitude of perihelion...	53 55 46·4	M.E. 1882·0
" ascending node ...	204 56 16·8	M.E. 1882·0
Inclination	73 48 32·3	
Logarithm of perihelion distance ...	8·7837199	

Motion—direct.

We are not aware that any complete observation of a comet on the meridian at noonday has been made since the year 1744. The grand comet in the early part of that year, first remarked by Klinkenberg at Harlem on December 9, 1743, attained an extraordinary degree of brilliancy towards the end of February. We find Bliss writing on February 12 (o.s.) to Lord Macclesfield, who had fitted up an observatory at Shirburn Castle, thus: "The comet appeared so very bright last night, equalling the light of Venus, that Dr. Bradley agrees that it may be seen on the meridian, and being engaged himself, has desired me to request your lordship to try to observe it. The elements which he left at Shirburn appear, to our last night's and former observations, to give the place true within 2′ of longitude and latitude." As a matter of fact the comet was observed on the meridian near noon, at Shirburn on the 28th and 29th of February, and at Greenwich on the 29th: these observations will be found reduced in Mr. Hind's paper on the comet of 1744 (*Astron. Nach.* vol. xxvii.)

Mr. Lewis Boss, the director of the Dudley Observatory, is to be congratulated on his success in the case of the comet of the present year. Excepting the days of observation, none of the remaining dates from June 5 to June 18 were clear enough at the comet's meridian passage: otherwise it is evident that Mr. Boss would have secured a perfectly unique series of positions.

GEOGRAPHICAL NOTES

COREA has at last followed the example of China and Japan, and cautiously opened a door or two to the outside "barbarian." From time immemorial Corea has been hemmed in by exclusive-

ness, and shares with Tibet the honour of being among the least-known countries in the world. Now, however, that both England and the United States have persuaded the Coreans to throw open four of their ports to commerce, we hope that our ignorance of an interesting land will soon be dispelled. Corea is almost half the size of France, and its population is variously estimated at from nine to fifteen millions. M. Elisée Réclus, in his "Geographie Universelle," compares the peninsula to Italy. Like Italy, it has a mountain chain running down the centre of the country, and giving off lateral valleys; as in the Apennines, the gentlest slopes and most fertile valleys are in the west, while the east is more precipitous and barren. As with Italy, Corea has in the north-west an Alpine mass, which guards her from intrusion there, though the mass does not really cover all the boundary. Of the geology we know but little, though many valuable minerals, including coal, are supposed to abound, and the country as a whole is capable of great development with proper guidance and suitable machinery. We trust before the inevitable Europeanising process is complete, that accurate information on the habits and customs, language, and ethnology of the Coreans will be obtained.

IN presence of the numerous and contradictory hypotheses as to the former geological history of the delta of the Amu-daria, it is obvious that no satisfactory scientific result as to the change of beds in the basins of the Amu and Syr-daria can be arrived at, without a thorough geological study of the different deposits of the rivers of the great Aral depression. A first step in this direction was made by the Amu-daria expedition; and now M. Hedroitz publishes, in the *Izvestia*, a valuable paper, giving the result of his researches in the same direction. Of course, one year is too short a time for thoroughly exploring this wide field; and M. Hedroitz's researches, however safe his method, and valuable his observations on the geological structure of alluvial deposits of different rivers of the Aral depression, on the motion of sand-dunes in the steppe, &c, are not yet sufficiently advanced to bring the author to a few general conclusions from his observations. His paper contains more valuable data than ready-made theories, and we hope that he will again return to the Amu to continue his researches. But one of his conclusions is worthy of notice. He does not admit that the Uzboy was a branch of the Amu-daria, as was admitted by the first explorers of this old bed. He supposes that there was a time (before the tenth century) when the Amu reached the Caspian, but by means of another bed which was situated south of the Sary-kamysh depression, leaving here the beds of "Amu-alluvium," which are seen in the lower parts of the Uzboy, but are missing in its upper parts. As to the Uzboy, it was but a temporary and irregular outflow of Lake Aral towards the Caspian, being rather a series of salt lakes and ponds, than a true river. Its name, Uz-boy (or "Uz-boyu," "along ponds"), would seem to confirm this hypothesis. The geological exploration would thus again call in question our established theories as to the former aspect af the Aralo Caspian basin.

HARTLEBEN, of Vienna, is issuing in parts a seventh German edition of Balbi's Universal Geography, under the editorship of Dr. Josef Chavanne, whose name is well-known as a scientific geographer and cartographer. Dr. Chavanne, to judge from the parts issued, is doing his work of editor conscientiously. In the mathematical and physical sections he seems to us to have brought the classical work abreast of the latest researches; and among the good points in the political geography are the statistics obtained at the recent censuses of 1881 and 1882, of all the leading countries of the world. While neither so detailed nor so picturesque as Réclus' "Geographie Universelle," the new edition of Balbi is perhaps more systematic and better adapted as a text-book, though it is published as a "house-book." With an exhaustive index the work will serve all the purposes of a succinct gazetteer.

THE leading article in *Petermann's Mittheilungen* for July is a long account of the unfortunate *Jeannette* expedition, with a map showing its drift from East Cape, north-west, to Bennett Island, and the route of the boats south-west to Lena mouth, after the loss of the vessel. The course of the expedition within two years was thus within very narrow limits, and the gains to science can be of comparatively small moment. A long letter from Dr. Emin-Bey describes his journey in the east of Bahr-el-Jebel, in March, April, and May of last year. Among the notes is a letter from Dr. Schweinfurth, describing the results of his journey in April and May this year, along the Nile above Siut, for the purpose of collecting data for his map of the Nile valley; he gives some notes on the geology of the region.

THE following extract from a letter from Mr. W. Thomas, Meteorological Office Reporter at Scilly, to Mr. Robert H. Scott, F.R.S., Secretary to the Meteorological Council, has been sent us for publication:—"Scilly, July 14, 1882. I beg to inform you of a curious disturbance of the sea at 9 a.m. yesterday, July 13, about low water, the wind S.S.W. The water flowed rapidly up to 3 feet perpendicular, and then ebbed out again. It flowed and ebbed three times; the second and third time was not so high as the first. From the first to the last was about half an hour.

THE *Bolletino* of the Italian Geographical Society for May and June contains a detailed account of the work of the expedition under Capt. Cecchi in Shoa, with a map.

THE Danish Arctic Exploring Expedition under the command of Naval Lieut. Hovgaard, sailed on Tuesday on her expedition.

THE Geological Society of Stockholm has despatched an expedition to Spitzbergen, having for its special object the increase of our knowledge of the vegetable palæontology of the island.

BAROMETERS

THE subject is so old and well-worn that it is impossible to add anything new to it, still it is so large that there is no fear of its being exhausted by the few following notes. It will be going back quite far enough if we begin with Hook (*Phil. Trans.* i., 218, 1666), who invented the wheel barometer, and point out that *his* (1666) method consisted in using a mercury trough formed of two short open cylinders communicating near the bottom). Into one of these the lower end of the barometer tube was inserted while the float connected with the index rested on the mercury in the other. Derham (*Phil. Trans.* xx., 45, 1698), avoided the uncertainty caused by the float, cord, and index-bearings, and took his readings by means of a rod (terminating in a point) connected with the index by a rack and pinion. Gray (*Phil. Trans.* xx, 176, 1698) in the same year proposed the very method that is now in use for taking observations with the standard barometers, for he left the barometer tube free of all fittings and attachments, and read off the actual height of the mercurial column by means of a microscope (*sic*) sliding on a vertical scale. Fitzgerald (*Phil. Trans.* lii., 146, 1761) attached two movable indexes to the dial of the wheel barometer to show the highest and lowest points reached during any given period; and he also gave the float nearly the full range by having the upper part of the tube three inches in diameter, while the short upturned end was only half an inch diameter. In 1770 (*Phil. Trans.* lx., 74) he increased the range of the index by introducing a system of levers with arms of unequal length.

The earliest suggestion for increasing the sensitiveness of the barometer was made (1668) by Hook, who fixed over the mercury a narrow tube containing spirit. Descartes also proposed that same form of instrument which was made by Huyghens; but the uncertainty caused by the vapour-tension of the spirit rendered the readings so valueless that Huyghens (and this method was also claimed by De la Hire) connected the capillary tube with the shorter upturned end of the barometer, and thus did not interfere with the vacuum. Rowning employed the same principle, but bent the fine tube over, so that (though still parallel to) it was below the mercurial column; Hook's (*Phil. Trans.* xvi., 241, 1686) method of 1686 consisted in having enlargements at both surfaces of the mercury and another, open, over the capillary. Above the coloured spirit and water which came to a convenient height in the fine tube, he placed turpentine sufficient to partly fill the open enlargement. As the rise in the spirit-column was thus compensated (or nearly so) by the shortening of the turpentine column, it had no appreciable effect on the level of the mercury. The conical or pendant barometer of Amontons (1695) consists of a conical tube of very fine bore, containing the mercurial column, suspended with the wider end downwards. When the pressure of the air increases the mercury rises in the tube, but owing to the diminished diameter it occupies a greater length; when the pressure is less the column descends, until on reaching a wider part of the tube it is sufficiently shortened to restore equilibrium. Theoretically the range may be increased to any extent by having a tube of only

very slight taper, but in order that the column may not break the bore must be so small that friction and capillarity render correct graduation impossible. Whiting (*Pogg. Ann.* cxvii., 656, 1862) proposed in place of that to use two tubes of different diameters joined together with, at lower surface of mercury, an ivory plate with a little glass bulb attached above it. In the horizontal barometer of Bernoulli and Cassini the longer range is obtained by enlarging the tube at the upper level of the mercury and replacing the cistern by a tube of fine bore bent at a right angle. In Sir Samuel Moreland's *diagonal* barometer the top part of the tube is bent more or less from the perpendicular. It is said to have been invented by Derham, as he refers to his "former communication about a crooked tube." The instrument at South Kensington bears date 1750, and was made by Watkins and Smith, London; that at Peel Park, Salford, is by T. Whitehurst, Derby, 1772; there is also one in the museum at King's College. Hicks (*Prov. Prot.* No. 740, 1862) proposed to increase the range by terminating the tube at the top in a coil. The *maximum* registering barometer of Traill is the same as the diagonal, but with the addition of a short steel rod in the tube above the mercury; his *minimum* is on the same principle as the horizontal barometer, but the bottom open tube forms a smaller angle than a right angle with the vertical tube. The steel rod is placed in this open tube above the mercury. Howson's (*Pat.* No. 1616, 1861) is on an entirely different principle, as in it the cistern is supported by the floating power of a sealed glass tube which is inserted in the mercurial column, and is attached to the bottom of the cistern. This was reproduced by Vidi (*Les Mondes*, iii., 25, 1863) two years later.

As the absence of air above the mercury renders the tubes very liable to fracture, from the bumping of the column against the top, when barometers are carried or moved, the means of rendering the instruments more or less portable has occupied the attention of several. Nairne long ago overcame this difficulty by making the lower half or two-thirds of the tube of very fine bore. Passemente (1758) adopted the expedient of twisting the middle of the tube so as to form two or three coils of a flattened spiral. Spry (*Phil. Trans.* lv., 83, 1765), who unfortunately gave no illustration, wrote, "The small bowl at the top with beads therein, render it far less liable to break by the mercury's ascent, the bowl giving it an immediate expanse from the column, and the beads counteracting in force as so many springs." Uzielli (*Deut. Chem. Ges. Ber.* v., 1055, 1872) makes a somewhat similar proposal: "Above 800 mm. a glass valve is inserted in the tube, so that by inclining the tube the mercury rises above the valve; then, on bringing the tube upright again, the air is above the valve and the valve is sealed by mercury."

Recorders.—In Fontana's arrangement the barometer tube and short open tube are cemented into elbows at either end of a short horizontal tube (in this there is a stopcock). A float on the surface of the mercury in the open tube transmits its motion to a small section of a horizontal cylinder about 700 mm. in diameter, and covered with paper. Every hour an impression is made on this paper by a steel point moved by a clock. Kreils used a siphon barometer, and connected the float with the shorter arm of an unequal lever. The longer end of the lever carried a pencil, which, being struck every five minutes by a hammer moved by a clock, made a dot on a sheet of paper fixed to a frame drawn horizontally in front of it. Negretti and Zambra attach the float by means of cords attached to a balance with unequal arms to a pencil fastened to a square collar. This collar moves freely up and down a vertical rod of square cross-section; the rod is near the vertical cylinder round which the paper is wrapped, and the same clockwork which causes the cylinder to revolve moves the rod (at regular intervals) so as to bring the point of the pencil against the paper. Keith (*Encyc. Metrop.* 1845) attaches the recorder to the float rigidly by means of a thin steel rod; but he obtains nearly the whole of the movement of the mercurial column in the open limb by attaching to the upper limb a horizontal tube of large diameter. He thus makes the movement of the upper surface of the mercury scarcely perceptible. Redier (Symons' *Met. Mag.* x., 33, 1875) connects one pole of a battery to the float, and the other pole to a metal point which is lowered at regular intervals to make contact. The same clockwork which lowers the point draws a pencil along (but not touching) the paper which is wrapped round a horizontal cylinder. At the instant at which electrical contact is made the pencil marks a dot on the paper; it is then drawn back, and remains at rest for a certain time, when the operation is repeated. By this arrangement the ratio between the movement of the pencil and that of the float can be increased to any extent without offering any resistance to the movements of the latter. The same principle is employed by Hough; but as his instrument is a complete meteorograph, the mechanical details are varied in order that the movements of the barometer may be recorded on the same paper as those of the other instruments. Theorell's is a very similar instrument; but, by means of type, the record is made in printed numerals. It is not easy to decide under what heading Russell's instrument should be described, but this seems its most appropriate place. The barometer tube is fixed, but the cistern (which is a small one) floats in a vessel of mercury. The pen is attached to a rectangular framework which is drawn backwards and forwards once a minute in front of the paper. On electrical contact being made between a lever attached to the cistern and the side of a wire triangle attached to the pen-frame, the pen is pressed against the paper, and thus the position of the cistern is recorded.

Photographic Recorders.—In Brooke's (1846) apparatus a lever with arms of very unequal length has its short arm attached to a float, which rests on the mercury in the lower end of a large syphon barometer. The long arm carries a screen with a small hole in it; through this hole the light from a lamp produces a mark on a sensitive paper which is wound round a vertical cylinder moved by clockwork. Ronalds (Brit. Assoc. Rep. 346, 1851), 1847, of whose apparatus in the South Kensington Museum the only part visible is the *case* which, for aught one knows, *may* contain nothing, made the surface of the mercury trace its own line without the intervention of a movable screen. A lamp is placed behind the barometer tube and a lens is so adjusted that the surface of the mercury may throw its image on a sheet of prepared paper or a daguerrotype plate, which is moved horizontally by clockwork. At the same time correction is made for temperature by means of the metal rods which support the cistern of the barometer. In the improved form (Rep. Met. Comm. Roy. Soc. 40, 1867) of the instrument the sensitive paper is wound on a cylinder driven by clockwork, and the time is recorded by a stop which intercepts the marking for four minutes every two hours. The temperature-compensating apparatus is attached to the vertical slit at the barometer, so that an alteration in the temperature is indicated by a variation in the base line on the sensitive paper.

Volpicelli (*Compt. rend.* lxx. 334, 1870; *Les Mondes*, xxii. 365, 1870) constructed a barometer of which the following are the main details:—The millimetre scale is on a sheet of glass, and is photographed with the barometric variations. A solution of alum is interposed between the lamp and the mercurial column to intercept the heat-rays. It is arranged to allow the barometer to be read off without moving any of its parts. The interior of the casing is freely ventilated, and the clock which moves the paper makes a mark every hour, so that the record is uninterrupted.

Balance Barometers.—The Steelyard barometer (Moreland) is one of the oldest forms of the above. The tube is suspended to the shorter arm, and is balanced by the longer arm, at the end of which is the pointer, which moves over a graduated arc. The cistern is but very little wider than the tube; thus when the atmospheric pressure increases, the pointer rises, and *vice versâ*. The static barometer (Magellan) is very similar, except that the balance has arms of equal length, and the tube is balanced by a weight; the pointer is attached under the beam, and the extremity of it moves to and fro along a horizontal scale. Wild, in his recording-barometer, uses a tube with an enlarged upper extremity, so that the variations in weight produced by the alterations in the pressure of the air may be considerable. A pencil at the end of the pointer, which is fixed below the beam, records on a horizontal cylinder. The balance has a bent beam, the arm from which the tube is suspended being horizontal, and the arm to which the counterpoise is rigidly attached descending obliquely. Secchi (1867) used a slightly-bent beam with arms of equal length; the pointer which descended from the beam terminated at its lower extremity in a hinge, to which was attached one end of the horizontal rod, which carried the recording-pencil; parallel motion was obtained by a rod to which the other end of the horizontal rod was hinged. The record was made on a flat descending sheet of paper. Brassart (1872) did not in any way alter the principle of the instrument, but arranged it in a slightly different manner, so as to render more compact the meteorograph of which it formed a part. Schreiber makes his instrument record on a vertical revolving cylinder by means of a pencil attached to a rod suspended from the other arm of the

balance; this rod hangs free, and is hit by a hammer, moved by clockwork, at intervals of ten minutes.

O'Reilly's is a balance barometer, but not at all similar to the foregoing, as the cistern is fixed to the tube, and the instrument is inclined from the vertical, and suspended by knife edges. The variations in the length of the mercurial column cause it to incline more or less, the amplitude of movement showing itself on a graduated arc by means of an index.

Cantoni employs a balance, but he has the tube fixed, and suspends the cistern, which is a small one, from one arm of the beam, to which is attached (underneath it) a pointer. Cecci adopts the same principle, but traces the record on smoked glazed paper (wound round a horizontal cylinder) by means of a long pointer fixed over the beam. The floating barometer of McGwire (Irish Acad. *Trans.* iv., 141, 1791) is a balance barometer, as its weight is counterpoised, or nearly so, by the wooden ring attached to the bottom of the tube. A very similar instrument was patented by McNeill (Patent, No. 1733, 1861).

Cistern Arrangements.—Prins maintained that by the following arrangement he obtained a constant level in the cistern. The reservoir has a glass cover a little below its rim; this cover has a hole in the centre rather larger than the tube which passes through it, through this space the mercury rises and spreads more or less over the cover. In Gloukhoff's barometer the mercury in the cistern is forced by means of a screw to pass through a hole, and to cover a glass ring. Then the movable scale is lowered so as to make the steel end touch the surface of the mercury. Amagat proposed to adjust the level in the cistern by means of an iron or glass cylinder which was forced down by a screw. Poleni (1740) adjusted the level by the immersion of a screw. Austin (Roy. Irish Acad. *Trans.* iv., 99, 1791) kept the level of the mercury in the cistern constant by overflow from an aperture in the side into a bag underneath. Hamilton (Roy. Irish Acad. *Trans.* v., 95, 1792) fitted his barometer with an ivory cistern, the upper part of which was closed by a cork ring; this being porous allowed air to pass through, but retained the mercury. The cistern which is most used is that of Fortin; it is a short, wide, glass cylinder which is fixed by three pillars, the ends of which have screws passing through an upper and a lower brass plate, by means of which the necessary pressure can be applied to make it mercury-tight. At the bottom of the cistern is a leather bag, which is raised or lowered by an adjusting screw, so that the surface of the mercury may be brought into contact with an ivory point which forms the zero of the scale; this point is seen through the glass cistern. The cistern of Green's barometer, which is used by the United States Signal Service, is essentially the same as Fortin's. Negretti and Zambra (Patent, No. 238, 1861) patented the following. The cistern is screwed at the upper part to fittings near the bottom of the tube, so that by turning it round it will be raised until a cushion or pad placed at the bottom of the cistern is brought up against the open end of the tube. Alvergnat (*Rev. Hebd. d. Chim.* March 1870) proposed a very elementary form on the same principle. Paul de Lamanon ("Observations sur la Physique," xix., 3, 1782) in order to determine to what extent the expansion of the mercury influenced the height of the column, marked a zero point on the shorter limb of a siphon barometer. Gay-Lussac (*Ann. de Chim.* i., 113, 1816), who pointed out that, by having the tube of the same diameter at both surfaces of the mercury, correction for capillarity was unnecessary, also made his barometer portable by sealing the top of the shorter limb with the exception of a very fine hole. At the same time he made the lower portion of the longer tube and the bend of tube of sufficiently small diameter to keep the mercurial column from breaking. Bunten introduced a great improvement by inserting an air-trap in the barometer tube. This he effected by drawing off the lower extremity of the upper half of the tube to form a capillary; he then sealed the lower half of the tube to the shoulder of the contraction, so that any air accidentally entering the tube would collect round this shoulder and not break the continuity of the column or destroy the vacuum. Lefranc (*Pogg. Ann.* lxxiv, 462, 1849) objected to Bunten's tube as being very liable to fracture, and proposed to guard against the admission of air by drawing off the lower limb of the siphon to a capillary tube, and then fitting to this tube by means of a perforated cork a short tube which is, midway, contracted to a very small diameter. De Luc used the siphon barometer, but made the instrument portable by inserting in the shorter limb an ivory stop-cock which had a cork plug, but with a small ivory tube in the cork. Blondeau constructed a very similar instrument, but made it of iron, and took his readings by means of a float. Stevenson's is an iron siphon barometer provided with stop-cocks at both limbs, so that it can be easily charged or emptied. Bogen (Patent, No. 2532, 1877) patented the following barometer:—The long leg of the siphon is closed at one end, and is supplied with a glass stopper, with a fine hole through it, at the other. The tube is filled, the stopper is inserted, and, the hole through the stopper being closed by the finger, the tube is inverted and a portion of the mercury allowed to flow away to produce a vacuum. The short leg is of the same diameter, and is formed with a semicircular bend at one end, which is ground to receive the open end of the long limb. The short limb is then partly filled with mercury, the two parts are fitted together, and the tube is brought to a vertical position. The level is read off by the same method as that employed by Derham, but with screw in place of rack and pinion. It stands on a centre, so that by turning the instrument round it can be seen whether the column is vertical. Greiner (Dove's *Repert. d. Phys.* i., 31, 1837), 1835, drew the bend off to a capillary, which entered the bottom of the open limb of the siphon. A short distance from the bottom this tube is contracted, and when the barometer is to be moved a plug is pressed into this contraction. W. Symons (Patent, No. 813, 1863) proposed to have no contraction, but to make the plug close the capillary opening. Dorwin (Patent, No. 1386, 1862) suggested a siphon barometer with cistern and stopcock in place of open limb; the cistern to be covered with chamois leather, and the stopcock to have india-rubber connectors above and below. Bohn constructs his instrument with enlarged tubes at the two surfaces of the mercury; the lower one surmounted by a narrow tube for the purpose of filling, and the upper one by a stopcock to facilitate the operation.

JAS. T. BROWN

ON MONOSTROMA, A GENUS OF ALGÆ

NOW that so much time and thought are devoted to the study of the green algæ, Dr. Wittrock's elaborate Monograph of the genus Monostroma [1] will be found a most desirable addition to our knowledge of these plants. The following abstract of this very interesting work may therefore not be unacceptable to the reader.

In the Introduction Dr. Wittrock, who writes in Swedish, relates all that is known concerning the history of the formation of the genus, the discovery of the species, the changes which have taken place in the classification, and the works which treat of the subject.

The genus Monostroma was formerly included in Ulva. Kützing was the first who divided the species of Ulva into those which were formed of one layer of cells and those which consisted of two layers. The former he called Ulva, the latter Phycoseris. Thuret afterwards formed the species with one layer into the new genus Monostroma. According to his arrangement Monostroma is included in the second order Zoosporeæ, sub-order, 1, Chlorosporeæ.

Of the affinities of Monostroma it will be sufficient to say that, through the bladder-like form at an early period of growth of two species, *M. bullosum* and *M. Grevillei*, (the *Ulva lactuca* of Harvey), it approaches to Enteromorpha, from which it differs in acquiring, at a later period, an expanded leaf-like form, whereas Enteromorpha always retains its tubular character. But a more effective distinction is found in the structure of the frond, which shows a nearer affinity with Tetraspora (which belongs to the Palmellaceæ). The chief distinction between Monostroma and Tetraspora lies in the zoospores, which, in *M. bullosum*, are (as in the other Ulvaceæ) oval, with the smaller end somewhat drawn out into a kind of beak (rostrum), to which cilia are attached. In Tetraspora the zoospores are nearly round, without a rostrum, but with two long cilia fastened to the zoospores, which can only be distinguished by their lighter colour.

To Prasiola Monostroma is also near. From this it is distinguished by the position of the cells, which are here never arranged in quadratic or rectangular groups, and by the holdfast or root-organs.

The frond (thallus) in Monostroma, at least in mature specimens, is a flat, membranous expansion. In two of the species it is, when young, in the form of a bladder or closed bag, which soon splits

[1] Försök till en Monographi öfver Algslägtet Monostroma, af V. B. Wittrock. Upsala, 1866.

and spreads open. In some species the frond is more or less lobed and laciniated, the margins either undulated, entire, or jagged. The colour is always greenish, passing sometimes from yellowish to white, and, in one species, is quite dark.

In the young state the frond always adheres to some object, such as stones, rocks, or other algæ, but in most species it becomes detached, and lies at the bottom of the sea.

As to the internal structure of the frond, it is, on the whole, very thin, and the principal part is formed of a single layer of cells, which lie in the same plane. It is provided with a more or less abundant intercellular substance, and is held together by a cuticle, which incloses the whole frond.

The lower part of the frond, when attached to some object, has a more compound structure. The cells, as regards their form, situation, and other particulars, are more developed. In mature specimens of all the species yet examined, except *M. bullosum*, they are often of a lengthened club-shaped form, and lie with their thickened ends side by side, while the smaller ends wind about each other, and sometimes almost interlace. The cells are, moreover, of larger size than those in the upper part of the frond, so that the lower part of the frond is much thicker than the upper. In some cases other cells, resembling those in the upper part of the frond, are mixed with the club-shaped cells. From a transverse section of this part of the frond it would appear to be formed of two or even three layers of cells, of which only one is single, namely, that which is formed of the thickened ends of the cells; the other consists of their thin ends and of smaller cells. Somewhat different arrangements of the cells of the lower part of the frond are noticed in the description of species.

It is, therefore, the upper part of the frond only which is monostromatic. The cells in this part vary in form; some are rounded and have rather prominent angles, others are angular, with the angles sometimes rounded off, but occasionally quite sharp. Their longest axis is sometimes at right angles with the surface, at others it is horizontal. As to the position of the cells with regard to each other, in some species this is irregular, without any special order; in others the cells are grouped with more regularity two and two, three and three, or four and four together. They are separated more or less by the intercellular substance. The species which give the best examples of this kind of grouping are *M. bullosum*, *M. laceratum*, and *M. quaternarium*.

The substantial part of the frond consists of an inclosing membrane and its contents. The membrane, which is a true cellulose membrane, is, in mature examples, of most of the species very thin, and quite hyaline, therefore very difficult to detect. The most important part of the cell contents are the chlorophyll-bodies which are coloured by chlorophyll. In some species they fill the cells entirely and naturally take their form; in others they fill only half or even a less portion of the cells, and lie like a band across the cells parallel to the surface of the frond.

Within the chlorophyll-bodies are found abundantly round grains of starch; except for these the contents of the upper part of the fronds are tolerably homogeneous.

No nucleus (*cellulkärna*) has as yet been observed with certainty. In the monostromatic parts of *M. Grevillei* there are often seen, about the centre of the cells, almost circular light spots which remind one of a nucleus, but of which the nature has not yet been ascertained. The cells of which the lower part of the frond is composed have already been noticed; it is only necessary to add that the cells here are never so close together as in the upper part of the frond, and that the interstices are filled with small portions of the intercellular substance.

The chlorophyll-bodies in the club-shaped cells never fill the entire space, but keep strictly to the form of the cells, and long streaks of this substance pass through their shafts quite to the point. Starch grains, or at least starch in an amorphous state, is here always found, and even when it could not be observed the chlorophyll bodies always assumed a dark-blue colour when iodine was applied.

The intercellular substance plays a considerable part in the structure of the frond. In some species it forms as much as half of the whole mass. In others, and these are the most numerous, it is less in quantity but of equal importance. It lies, in all the species, with one exception, not only between the cells themselves, but also in the large space between the cells and the cuticle.

The cuticle is very thin and pellucid, and covers the whole frond except the fibrous-rooting processes (*fästtågorna*) before mentioned.

In the young state the frond is attached to some object by a hold-fast ((*fästnöl*), which is formed partly of the intercellular substance, and partly of the lower parts of the club-shaped cells at the base of the plant. The ends of these cells and the intercellular substance are both inclosed by the cuticle. The hold-fast is irregular in form, rather flat, and always very small. Instead of this hold-fast, two of the species are provided with rooting processes (*fästtågorna, fibrillæ alligantes*), which consist of a few simple fibres, and which are found on older plants after they have become detached. These fibres are nothing but the ends of the shafts of the club-shaped cells, which, instead of remaining within the cuticle, push through it, and take the place of the hold-fast.

By these root organs is Monostroma, well separated from Prasiola, to which it is otherwise near. The root-organs in Prasiola are, as Jessen has shown in his meritorious monograph on the genus Prasiola, very different. Whereas in Monostroma the cells partake in forming the hold-fast, in Prasiola the fibres proceed from the intercellular substance, and are inclosed in the cuticle. In Monostroma the fibres are simple, but in Prasiola they are branched, sometimes even anostomosing, and, in parts, almost reticulated.

Monostroma is entirely without special reproductive organs, but when the plant has reached maturity the cells become fruitful. At a certain period the contents of the cells are transformed into zoospores, which, after swimming about for a short time, fix themselves to some object and develop into young plants. As there are at least four zoospores in every cell, a middle-sized frond must produce many thousands of them; hence it will be seen what a powerful means they are of increasing and multiplying the plant.

The exact nature of these small organs has not been thoroughly studied. For what is known on the subject we are indebted to Areschoug's able essay "On the Formation of the Zoospores in *M. Grevillei*," and also to Thuret's remarkable work, "Recherches sur les Zoospores des Algues."

Nothing is known as to the way in which the zoospores are formed in the cells. All that is really known is that the parts of the cells which undergo transformation are the chlorophyll bodies, but how the green contents of the cells change into zoospores, and whether by successive or by simultaneous division, are problems still enveloped in total obscurity.

When the zoospores are formed numbers of them lie in the cells moving about their smaller ends. After a time they lie still; then, under the influence of light, they may be seen turning about in their cells as if struggling to get out of their narrow prison. A round hole then forms in the cell-membrane and in the cuticle, whence the zoospores speedily escape. After a short time the motion ceases, and they lie in the cells, where they probably soon die.

The time of the day when the zoospores issue from the cells is generally between four and six in the morning. Sometimes, especially in autumn, the swarming takes place later in the day, even in the afternoon. In some of the Ulvæ, according to Thuret, the swarming does not occur at any special time of the day.

The zoospores, in the species which are best known, are of an oval form, the lower end being drawn out into a rostrum, to which are attached two cilia, of about the same length as the zoospores. Sometimes there are found in all the species two kinds of zoospores, the one with four, the other with two cilia. The former are nearer to germinating spores, the latter to resting spores. In many other Ulvaceæ two kinds of zoospores have also been observed.

The colour of the zoospores is green, but the smaller end is lighter in colour or almost hyaline. The cilia are always colourless.

The free zoospores have a voluntary motion, and two distinct movements. First, they turn quickly each on its own axis, and secondly, they move now forwards, now in circles, then in straight lines, now one way, then another.

As to how this motion is produced, and which part of the zoospores is most efficacious in causing it, various opinions prevail. Up to the present time the most general belief is that the cilia are the locomotive organs. Another opinion was, however, expressed by Prof. Areschoug in the *Transactions* of the Academy of Upsala for the year 1866, namely, that the

zoospores in motion have a power of contracting and expanding very quickly, and of very considerably changing their form; this changing of form, he considers, constitutes in itself the mechanism of motion. In this essay he has clearly proved that in the algæ then under examination, the cilia cannot be the true organs of motion.

The zoospores originate always in the cells that lie on or near the margin of the frond; they afterwards appear in abundance in the upper parts of the frond, whence they spread gradually downwards, till they fill up all the cells of the monostromatic part.

When the motion finally ceases, the zoospores fasten themselves to some object near at hand, and then begin to develop into young plants. The zoospores which, till this time, were formed of the bare protoplasm only, are now covered with a cellular membrane. The cilia disappear, and a process of division commences, which, however, in the species of this genus, has not been studied. In several other well-known Ulvæ, this division takes place first in one dimension, but afterwards in two; thus an expanded membrane is formed. This increase in size takes place, according to the observations of authors, principally, but not exclusively, in the periphery of the frond, or on the apex, if there be one. The youngest parts of the plants are thus always at the top, and the oldest at the base. In this way the frond acquires a tolerable leaf-like aspect.

As before-mentioned, the frond does not in all the species remain attached during its whole life to some object. It is often found, fresh and in full vigour, lying loosely at the bottom of the water in which it grew. Thus, according to the experience of authors, these free examples are entirely monostromatic. Hence there is reason for the opinion that, in this case, the frond divides itself into two parts, and that the division-line between them falls just on the border between the upper monostromatic part of the frond and the lower, and not monostromatic. The upper part of the frond survives for a considerable time, and generally increases in size, until the formation of zoospores begins, when it gradually decays. The fate of the other part of the frond is involved in obscurity. Dr. Wittrock thinks it not improbable that the cells may detach themselves from each other, and become a kind of fixed gonidia, which finally develop into young plants. Such a mode of increasing would agree with that which, according to Kützing, occurs in several species of the genus Ulva of authors (*Phycoseris*, Ktz.), where the cells in the stipes of the plants, after the frond becomes free, put forth budding-cells. It also occurs in Prasiola.

Kützing, in his works, speaks of another kind of reproductive bodies, the so-called *Spermatia*, which he says occur in the Ulvaceæ. He describes them as brown, and as detached from the surface of the frond, also as round bodies with a thick hyaline membrane, the contents of which are brown and granular. In *Ulva latissima*, Ktz., to judge from the figure, they appear to be about three times as long as the outer cells. Dr. Wittrock had been unable, after diligent search, to find them. To Thuret their use was unknown, and Jessen supposed that they proceeded from some accidental deformity of the common cellular tissue.

No genus in the whole vegetable kingdom has so wide a range as Monostroma. It has representatives in all parts of the world, but the greater part of the species prevail in the colder parts of the European temperate zone. Of the eighteen species which are known with tolerable certainty to belong to the genus twelve are found in this zone. In the southern part of the Polar regions the genus has not less than seven representatives; in the equatorial zone one species is found; south of the range of the "wild goat," only two. In Europe there are fifteen species; in Asia, two (or, including *M. fuscum*, three); in Africa, one; in North America, one; in South America, one; and in Australia, three species.[1]

Many of the species grow in salt water, some prefer brackish, others inhabit fresh water. They grow generally in shallow water, most frequently only one or two feet below the surface; but two species often grow many fathoms under water. Some species are found at nearly all times of the year, others in the spring and summer only. All are annuals.

To facilitate examination and to preserve as much as possible the natural order, Dr. Wittrock has subjoined a tabular view of the species which he has examined. The characters are here adduced partly from the form and position of the cells as shown in a transverse section of the frond, partly from the development of the chlorophyll bodies and the thickness of the frond. The arrangement of the species in this scheme is not altogether the same as that afterwards observed in the treatise.

The species are fully, even minutely described, and the monograph is illustrated by four plates, in which magnified figures are given of the surface and transverse sections of the fronds. These are extremely useful, since the species can be determined by microscopic observation only. MARY P. MERRIFIELD

[1] At present three species only of Monostroma are known to grow on the British shores, namely, *M. bullosum*, *M. Grevillei*, and *M. latissimum*. The first inhabits fresh water, the others salt water. On the north coast of France five species are found.—M. P. M.

SCIENTIFIC SERIALS

IN the most recent numbers of the *Journal of Botany* (May-July), the most interesting article is perhaps the description of a new British Umbellifer, *Selinum Carvifolia*, by Mr. F. A. Lees, illustrated by a plate. The plant is widely distributed on the Continent, and has been now discovered in Lincolnshire by the Rev. William Fowler. It has apparently been confounded with *Peucedanum palustre*, to which however it is not very nearly allied, and should be looked for elsewhere.

THE recent numbers of the *Scottish Naturalist* (October 1881-July 1882) contain the usual supply of articles on various branches of natural history, especially interesting to dwellers in or visitors to the northern parts of our island.

The American Journal of Science, June.—Respiration of plants, by W. P. Wilson.—On the question of electrification by evaporation, by S. H. Freeman.—Observations on snow and ice under pressure at temperatures below 32° F., by E. Hungerford.—On the minerals, mainly zeolites, occurring in the basalt of Table Mountain, near Golden, Colorado, by W. Cross and W. F. Hillebrand.—On a new locality for Hayesine, by N. H. Darton.—Notes on the electromagnetic theory of light, II., by J. W. Gibbs.—New phyllopod crustaceans from the Devonian of New York, by J. M. Clarke.—An organ-pipe sonometer, by W. Le Conte Stevens.

THE *Journal of the Franklin Institute*, July.—Description of the Edison steam dynamo, by T. A. Edison and C. T. Porter.—On the efficiency of the steam boiler, and on the conditions of maximum economy, by R. H. Thurston.—Note on the economy of the windmill as a prime mover, by A. R. Wolff.—Harmonic intonation of Chime bells (continued), by J. W. Nystrom.—An organ-pipe sonometer, by W. Le Conte Stevens.—Analysis of Helvite from Virginia, by R. Haines.—The absorption of metallic oxides by plants, by F. C. Phillips.—Applications of the principle of the phonodynamograph, by W. P. Cooper.—Remarks made at the closing exercises of the drawing school, May 18, 1882, by C. Sellers, jun.—Conservation of solar energy, by P. E. Chase.

THE *Bulletin of the Torrey Botanical Club* for April contains an interesting article by Mr. T. F. Allen on the "Development of the Cortex in *Chara*," illustrated by 8 plates. The author divides the species belonging to the genus into eight groups, characterised by the mode of development of the cortical cells and cortical tubes. Three new species are described.

Annalen der Physik und Chemie, No. 6.—On the electricity of flame, by J. Elster and H. Geitel.—On double refraction in glass and sulphide of carbon produced by electric induction, by H. Brongersma.—On measurement of small electric resistances, by C. Dieterici.—Note on weakly magnetic and dia-magnetic substances, by P. Silow.—Some experiments on diffusion of gases through hydrophane of Czernowitza, by G. Hüfner.—General formulæ for determination of the constants of elasticity of crystals by observation of the flexure and drilling of prisms, by W. Voigt.—On the molecular attraction of liquids for each other, by P. Volkmann.—Reply to the memoir of Herr V. v. Lang: "Determination of the quotients of refraction of a concentrated solution of cyanin," by C. Pulfrich.—Experiments on colour-mixtures, by R. Schelske.—A proof of Talbot's proposition, and remarks on some of its consequences, by F. Boas.—On the replacement of a centred system of refracting spherical surfaces by a single one of this kind, by F. Kessler.—On singing condensers, by W. Holtz.—On coloured sparks and their production by internal and external resistances, by the same.—Remarks on the production of Lichtenburg figures, by K. L. Bauer.

No. 7.—On transpiration of vapours (III. Memoir), by V. Steudel.—On the same, (IV. Memoir), by L. Meyer.—General formulæ, &c. (continued), by W. Voigt.—Volume and angular

changes of crystalline bodies with omni- or uni-lateral pressure, by the same.—On the absorption of heat by gases and a method based thereupon for determination of the amount of carbonic acid of atmospheric air, by H. Heine.—On the absolute system of measurement, by P. Volkmann.—Deduction of the fundamental law of crystallography from the theory of crystalline structure, by L. Sohncke.—On the molecular-kinetic laws of heat of vaporisation and the specific heat of bodies in various forms of aggregation, by A. Walter.—On the different systems of measures for measurement of electric and magnetic quantities, by R. Clausius.—On the metallic galvanic battery of Perry and Ayrton, by B. J. Goosens.—The Waltenhofen phenomenon and the demagnetisation of iron bodies, by F. Auerbach.—On the behaviour of electricity in gases, by F. Narr.

Reale Istituto Lombardo di Scienze e Lettere, Rendiconti, vol. xv. fasc. xi.—On some formulæ relative to calculation of errors of observation, by S. Maggi.—On two fossiliferous planes of the Lias in Umbria, by C. F. Parona.—On the variability of *Cobitis tænia*, by E. Cantoni.—On caffeic acid obtained from *Cinchona cuprea*, by G. B. Körner.—On an herbarium about 3000 years old, by G. Cornalia.

SOCIETIES AND ACADEMIES

London

Anthropological Institute, June 27.—General Pitt-Rivers, F.R.S., president, in the chair.—Mr. Villiers Stuart, M.P., exhibited and described a drawing of the funeral canopy or tent of an Egyptian queen, and some casts of bas-reliefs discovered by him within a short distance of the tent.—Mr. E. H. Man read a further account of the natives of the Andaman Islands, in which he treated more particularly of their home life; the food and methods of cooking were fully described; also the games, amusements, and dances.—A communication was received from Mr. H. C. R. Becher on some Mexican terra-cotta figures found near the ancient pyramids of San Juan Teotihuacan; from a comparison of these figures with those in the museum at Palermo the author argued that they were produced by people of the same race, and that the builders of these ancient monuments were Phœnicians.

Royal Horticultural Society, June 27.—Sir J. D. Hooker in the chair.—*Hollyhock attacked by Fungi:* Mr. W. G. Smith exhibited fruits, and an enlarged drawing, showing them to be often badly attacked by *Puccinia malvacearum*, and a *Cladosporium*, which would probably account for the presence of the Uredo noticed by Mr. Berkeley in the germinating plants.—*Hybrid Lily:* Mr. G. F. Wilson exhibited a very remarkable hybrid between *L. Washingtonianum* and *L. superbum*, which had the foliage of the former, but flowers more like those of the latter.—*Synanthic campanulas:* Mr. G. S. Boulger mentioned that Mr. Gibbs, of Chelmsford, had fertilised a common form of Campanula (with catacorolla), with the pollen of a synanthic blossom. He had raised 200 plants, and many had synanthic flowers.—*Retinospora sport:* Dr. M. T. Masters exhibited a specimen of *R. squarrosa*, which had borne a branch with the characters of *R. pisifera*, proving these supposed species to be one.—*Monstrous Flowers:* Dr. Masters exhibited virescent flowers of Auricula; Mr. Laing, a rose-pink double Begonia, with axillary prolifications of double flowers besides a terminal one, all proceeding from the centre of a male flower; the female flowers being compact and double, but not proliferous to the same extent.—The Rev. G. Henslow exhibited a branch of wallflower covered with minute and almost capillary leaves.

July 11.—Dr. M. T. Masters in the chair.—*Hollyhock disease:* Mr. W. G. Smith exhibited fruits of *Malva sylvestris* with *Puccinia malvacearum*. They confirmed the correctness of his view that the fruits infected by this fungus fall to the ground, and are then capable of producing seedlings diseased with *Uredo* without the intervening *æcidium* stage, as in the case of the hollyhock mentioned above.—*Scolopendrium, diseased:* he also showed the harts-tongue fern attacked by *Didymium effusum*, Lk., a myxomycetous fungus, new to Great Britain. It occurs on both sides of the frond, and grows over the ruptured masses of spore-cases, and even amongst the free spores (for description and figures see *Gardeners' Chronicle*, July 15, 1882).—*Clematis and oat* roots attacked by vibrio (*Tylenchus*, sp.?): Dr. Masters showed specimens and observed that it was only one variety of black oat which was attacked, but that to such an extent as to destroy whole crops.—*Gardenia and Petroleum:* he brought a spray to show its healthiness after being treated by syringing with this oil and water (a wine-glass to a gallon), to destroy mealy bug.—*Water-lily with foliaceous sepal:* he also exhibited a specimen in which one sepal had developed a leaf-blade at its apex, proving that (as is usually the case) a sepal is homologous with the basal part of the petiole only.—*Coloured pea-pods:* Mr. Laxton of Bedford sent green, purple, and speckled pods, the latter a result from crossing the two former. The purple colour appears to overlie the chlorophyll, which it thereby conceals.—*Antirrhinum Hendersoni:* Mr. Cannell forwarded sprays of this race, which has white flowers with crimson border, but which will not set seed, this being apparently due to atrophy of the pollen. The anthers had dehisced even in bud, and such few pollen-grains as were present were minute and abortive. The ovules, however, appeared to be normal; yet the race does not seem capable of being crossed. Mr. Henslow remarked that when white and purple snapdragons werh crossed the result is usually a streaked corolla with no certainty in the markings as in the present case.—*Aerial petato-tubers:* the Rev. G. Henslow exhibited tubers found in the axils of leaves. He also showed plum leaves perforated with small circular holes, caused by raindrops concentrating the sun's rays, which had thus burnt them.

Edinburgh

Royal Society, July 3.—Prof. Maclagan, in the chair.—Prof. Tait, in a note on the kinetic theory in relation to dissociation, stated that it followed from that theory as ordinarily enunciated that dissociation should take place at all temperatures, though of course very slowly at low temperatures. This, according to the chemists, was irreconcileable with the facts. It appeared, then, that a slight modification of the kinetic theory is necessary, so as to restrict the utmost ratio in which the velocity of an individual particle may exceed the velocity of mean square. This would entirely remove the difficulty, while in no way interfering with the success of the theory in other directions. A strong analogy in favour of this is afforded by the equation of diffusion and of conduction, from which an infinite velocity is assigned under certain cases to a particle of salt in water. This arises at once from the assumption that the diffusion is always directly proportional to the gradient of strength, however small that gradient may be.—Dr. Knott communicated a brief paper by Mr. Albert Campbell on experiments on the Peltier effect, in which the author had obtained by a very simple method the ratio of the Peltier effect for a given pair of metals at 20° C. to that at 100° C. The pairs he experimented on were iron-lead, iron-zinc, iron-german silver, and lead-silver; and the ratios obtained for these differed in no case more than 8 per cent. from the values indicated on Prof. Tait's thermo-electric diagram—a remarkably close agreement, considering how much metals of the same name differ in their thermo-electric properties.—Prof. Marshall read the continuation of the paper by himself, Prof. C. Michie Smith, and Mr. R. T. Omond, on the lowering of the maximum density point of water by pressure. They had repeated their former experiments with fresh water, and had investigated similarly salt water of about the same density as sea-water. Salt water apparently had no maximum density point at ordinary pressure—a fact previously known—or rather the maximum density point as calculated from a modification of Thomson's formula expressing the thermal effect due to any sudden compression in terms of that compression, is, so to speak imaginary, lying below the freezing-point. The results with salt water are important, as giving greater confidence in their method, so that the lowering of the density-point of fresh water by 5° C., by a pressure of one ton weight on the square inch may be accepted as not far from the truth.—The Rev. J. L. Blake read a paper on vocalisation and articulation, which was a continuation of his former paper on breath-pressure, and in which he considered specially the actions of the various muscles on the lungs and vocal organs in producing speech, pointing out what he considered the chief differences in the actions which accompany breathing, speaking, and singing.

Berlin

Physiological Society, June 2.—In our account of this meeting (NATURE, vol. xxvi. p. 216), by an oversight a page of the report was omitted. At the close of the notice of Prof. Kronecker's report on Dr. Melzer's experiments on the action of the vagus, and before the words "Since Hunter's time," the following paragraph should have been inserted:—"Prof. du Bois-Reymond read a second report on the recently instituted researches of Prof. Fritsch in Egypt and the Mediterranean, on electric fishes. After Fritsch had satisfied himself

as mentioned in the former communication, that Mormyrus was an electric fish, he thoroughly examined its central nervous system. He found the spinal marrow, when in a fresh state, to be a soft mass, which could be hardened by no medium so as to be made accessible for examination. On the other hand, the brain was of so high a degree of development, that it is even beyond that of the birds, and has a resemblance to that of a rabbit. Furthermore, Prof. Fritsch has examined a great number of Torpedoes from the Mediterranean, and he had made out four distinct species with their respective varieties. Into the specific diagnoses he introduced the number of the columns or pillars in the electric organs, and this because he found—as the result of a long series of careful countings—that the proposition as to the pre-formation of the electric organs (*i.e.* the doctrine that in the electric organs, after their first formation, no new elements are added), was true. The opposite view, that during growth new pillars were continually being formed, until very lately was almost universally held, and seems to have rested on Hunter's authority, who, towards the end of the last century, had made two series of countings, one on a common Torpedo, eighteen inches long, in which were 470 pillars, and one on a giant Torpedo, caught at Torbay, four feet in length, which contained 1182 columns. Hunter seems to have taken it for granted that the larger animal was but an older specimen of the same species, and had thence concluded that the pillars had increased during growth."

June 30.—Prof. du Bois-Reymond in the chair.—Dr. G. Salomon read a paper on his attempt to investigate more exactly the xanthin bodies of urine. He especially investigated the hypo-xanthin and its reactions, and in doing so found a new substance which easily crystallised, and which for the present he called para-xanthin, from its relation to xanthin. From the small quantity it was as yet not possible to make an accurate analysis of it, even though 500 litres of urine had been used in the investigations.—Dr. A. Baginski spoke of the anatomy of the colon in children. He endeavoured to find in the minute anatomy of the colon in infants, an explanation of the well-known fact that children during the first few years of their life can either not digest food containing starch, or at least do so with greater difficulty than adults. He found on the examination of the colon of the human embryo, and of infants up to their fourth year, that in the fœtus, and even after birth, there were no drusæ as yet in the mucous membrane of the stomach and colon, while in the infant the deeper lymphatic vessels were more strongly developed than in the adult.

PARIS

Academy of Sciences, July 10.—M. Blanchard in the chair.—The following papers were read:—On the differential equation which gives immediately the solution of the problem of three bodies to quantities of the second order inclusively, by M. Gyldén.—On various hydrates formed by pressure and release from pressure, by MM. Cailletet and Bordet. They compressed phosphuretted hydrogen in presence of water; on sudden release, crystals of what is doubtless a hydrate of phosphonium were formed within the tube. The critical point was + 28°. Other hydrates were had on treating similarly equal volumes of carbonic acid and phosphuretted hydrogen with water, dry phosphuretted hydrogen, and sulphide of carbon, and ammoniac gas in presence of a saturated solution of that substance (a hydrate of ammonia was formed in the latter case on the admission of some air).—Note on Brisinga, by M. Perrier. The *Travailleur* expeditions have yielded a splendid specimen, almost complete, sixteen well-preserved discs, two very young individuals, and a great many isolated arms. They are mostly *B. coronata*, the large one *B. endecacnemos*. A distinct form got in the Atlantic in 1880 is named *B. Edwardsii*. The development of *Brisinga*, bordering with that of crinoids on the one hand, is singularly like that of Ophiurides and Stellerides on the other.—Researches on the law of activity of the heart, by M. Dastre. He gives experimental proof that the law of periodic variation of the excitability (Marey) is an attribute of muscle, and that the law of uniformity of work or of rhythm (E. Cyon, Marey) is an attribute of the nervous apparatus.—Generalised and contagious *acné indurata*, having for origin varioliform or varioloïd acné, by M. Brame.—On a linear equation with partial derivatives, by M. Darboux.—On the ratio of the circumference to the diameter, and on the Napierian logarithms of commensurable numbers or of algebraic irrationals, by M. Lindemann.—Rectification, by M. Tannery.—On the conditions of achromatism in phenomena of interference, by M. Hurion.—Apparatus, with which may be recorded, in the form of a continuous curve, the liberation or the absorption of gases, and specially those which result from phenomena of fermentation and of respiration, by M. Regnard. Briefly, the gas from a vessel of liquid in fermentation acts on mercury in one arm of a manometer, a float in the other arm rises and pushes up one arm of a balance, making a platinum wire on the other arm dip in mercury and close a circuit. The current passes through two electro-magnets, one of which affects a style on a rotated blackened cylinder (through a ratchet and screw arrangement); the other, by raising a small bell out of mercury, releases the gaseous tension, so that the circuit is broken, and so on. The second apparatus, for respiration, is a slightly modified form.—Reply to M. Berthelot on the subject of the note "On the electromotive force of a zinc-carbon couple," by M. Tommasi.—On basic salts of manganese, by M. Gorgeu.—Action of bromine on quinoleine and pyridine, by M. Grimaux.—Researches on the curves of solubility in water of the different varieties of tartaric acid, by M. Leidie.—Botanical, chemical, and therapeutical researches on globularia, by MM. Heckel, Mourson, and Schlagdenhauffen. They differ from Walz about the chemical nature of the glycoid *globularine*, obtained (along with tannin, colouring matter, and cinnamic acid) by means of boiling water from the leaves. Instead of two products of decomposition under acids, they obtain only one, for which they keep the name *globularetine*; it is oily and resinous-looking after preparation, and becomes a transparent uncrystallisable mass. In hot caustic alkalis it dissolves, fixes the elements of water, and is transformed into cinnamic acid. Globularine contains also a little of a very volatile aromatic substance, which seems to be partly formed of cinnamate of benzyl.—On the presence of glycol in wine, by M. Henninger.—On the duration of the luminous perception in direct and indirect vision, by M. Charpentier. The person gave an electric signal on perceiving light through a hole in the bottom of a dark lined box, when a shutter fell from it. The interval studied (duration of luminous perception) varies in the same individual under like conditions, from simple to double, but a constant mean may be reached (*e.g.*, 13 hundredths of a sec., with daylight). It varies with different persons; is about the same with both eyes; is notably increased by other brain occupation; is greater in indirect than in direct vision; exercise attenuating but not suppressing the difference. Exercise for many days lessens the duration, but in certain curious ways for different parts of the retina.—Regeneration of peripheric nerves by the process of tubular suture, by M. Vanlair.—Experimental researches on the contractility of the uterus under the influence of direct excitations, by M. Dembo. The remarkable uterine excitability of the rabbit, may be connected with the fecundity of that animal. Dogs and cats gave slight contractions.—Analysis of the waters of the isthmus of Panama, by M. Aillaud. The waters of the Rio Grande, at a certain height, and before entrance into the marshy region, are potable.—On the coal basins of Tong-King, by M. Fuchs. The workable coal, to only 100 m. below the sea level, is estimated to be over five million tons. There are four different species in distinct groups of beds.

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